TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

Thirty-fourth Annual Meeting

JULY 25, 26 AND 27, 1905,

At White Sulphur Springs, West Virginia.

APPLETON, WIS.
THE POST PUBLISHING COMPANY, PRINTERS AND BINDERS.
1905.

Officers for 1905-1906.

President.....C. D. JOSLYN, Detroit, Mich.
Vice-President.....H. M. SMITH, Washington, D. C.
Recording Secretary.....GEORGE F. PEABODY, Appleton, Wis.
Corresponding Secretary, CHARLES G. ATKINS, East Orland, Me.
Treasurer.....C. W. WILLARD, Westerly, R. I.

* * *

EXECUTIVE COMMITTEE.

HON. W. E. MEEHAN, *Chairman*, Harrisburg, Pa.
JOHN D. WHISH, Albany, N. Y.
E. HART GEER, Hadlyme, Conn.
J. A. HENSHALL, Bozeman, Mont.
PAUL NORTH, Cleveland, O.
J. J. STRANAHAN, Bullochville, Ga.
S. F. FULLERTON, St. Paul, Minn.

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

NINETEEN HUNDRED FIVE

AMERICAN FISHERIES SOCIETY.

Organized December, 1870.

PRESIDENTS.

1.	William Clift	1870-1871
2.	William Clift	1871-1872
3.	William Clift	1872-1873
4.	Robert B. Roosevelt	1873-1874
5.	Robert B. Roosevelt	1874-1875
6.	Robert B. Roosevelt	1875-1876
7.	Robert B. Roosevelt	1876-1877
8.	Robert B. Roosevelt	1877-1878
9.	Robert B. Roosevelt	1878-1879
10.	Robert B. Roosevelt	1879-1880
11.	Robert B. Roosevelt	1880-1881
12.	Robert B. Roosevelt	1881-1882
13.	George Shepard Page	1882-1883
14.	James Benkard	1883-1884
15.	Theodore Lyman	1884-1885
16.	Marshall McDonald	1885-1886
17.	W. M. Hudson	1886-1887
18.	William L. May	1887-1888
19.	John H. Bissell	1888-1889
20.	Eugene G. Blackford	1889-1890
21.	Eugene G. Blackford	1890-1891
22.	James A. Henshall	1891-1892
23.	Herschel Whitaker	1892-1893
24.	Henry C. Ford	1893-1894
25.	William L. May	1894-1895
26.	L. D. Huntington	1895-1896
27.	Herschel Whitaker	1896-1897
28.	William L. May	1897-1898
29.	George F. Peabody	1898-1899
30.	John W. Titcomb	1899-1900
31.	F. B. Dickerson	1900-1901
32.	E. E. Bryant	1901-1902
33.	George M. Bowers	1902-1903
34.	Frank N. Clark	1903-1904
35.	Henry T. Root	1904-1905
36.	C. D. Joslyn	1905-1906

PART I.

BUSINESS SESSIONS.

Transactions of the American Fisheries Society.

Tuesday, July 25th, 1905.

Convention called to order at 12 M. by the President, Mr. Henry T. Root, of Providence, Rhode Island, at the Grand Central Hotel, White Sulphur Springs, West Virginia, whereupon the following proceedings were had:

President: Gentlemen of the American Fisheries Society, you will please come to order. The first order of business will be to secure the register of attendance, and I will ask Mr. Whish to make the register.

The registered attendance at the meeting of the society is as follows:

Atkins, Charles G., *East Orland, Me.*

Booth, DeWitt C., *Spearfish, S. D.*
Bower, Seymour, *Detroit, Mich.*
Bower, Ward T., *Northville, Mich.*
Bowers, Hon. George M., *U. S. Bureau of Fisheries, Washington, D. C.*
Brooks, Charles F., *Sandy Springs, Md.*
Brower, J. F., *Holmsburg, Philadelphia, Pa.*
Buller, A. G., *Erie, Pa.*
Buller, William, *Corry, Pa.*
Buller, N. R., *Pleasant Mount, Pa.*
Burner, W. J., *Durbin, W. Va.*

Clark, Frank N., *Northville, Mich.*
Cruickshank, James, *New York City.*

Dean, Herbert D., *U. S. Bureau of Fisheries, Neosho, Mo.*
Degler, F. A., *Cheat Bridge, W. Va.*

Dennis, Oregon M., *Baltimore, Md.*
Dinsmore, A. H., *Bucksport, Me.*
Downing, S. W., *Put-in-Bay, O.*
DePuy, Henry F., *New York City.*

Evermann, Prof. Barton W., *U. S. Bureau of Fisheries, Washington, D. C.*
Fullerton, Samuel F., *St. Paul, Minn.*

Gorham, F. P., *Providence, R. I.*
Greene, D. D. W., *Ohio Fish and Game Commission, Dayton, O.*

Haas, William F., *Corry, Pa.*
Harron, L. G., *U. S. Bureau of Fisheries, Washington, D. C.*
Hogan, James J., *La Crosse, Wis.*
Hubbard, Waldo F., *Nashua, N. H.*

Joslyn, C. D., *Detroit, Mich.*

Lydell, Dwight, *Mill Creek, Mich.*

Marsh, M. C., *U. S. Bureau of Fisheries, Washington, D. C.*
Meehan, W. E., *Commissioner of Fisheries, Harrisburg, Pa.*
Miller, Charles L., *Altoona, Pa.*
Morton, William P., *Providence, R. I.*

North, Paul, *Ohio Fish and Game Commissioner, Cleveland, O.*

Peabody, George F., *Recording Secretary, Appleton, Wis.*
Price, Andrew, *Marlinton, W. Va.*
Price, Calvin W., *Marlinton, W. Va.*

Roberts, A. D., *Woonsocket, R. I.*
Robinson, Robert K., *White Sulphur Springs, W. Va.*
Root, Henry T., *President, Providence, R. I.*

Safford, W. H., *Department of Fisheries, Bellefonte, Pa.*
Seagle, George A., *Wytheville, Va.*
Smith, Dr. H. M., *U. S. Bureau of Fisheries, Washington, D. C.*
Smith, Captain James A., *Baltimore, Md.*
Surber, Thaddeus, *White Sulphur Springs, W. Va.*

Talbott, Henry, *Interstate Commerce Commission, Washington, D. C.*

Thompson, James F., *Martinsburg, W. Va.*

Titcomb, John W., *U. S. Bureau of Fisheries, Washington, D. C.*

Townsend, C. H., *The Aquarium, New York City.*

Venn, Harry S., *White Sulphur Springs, W. Va.*

Whish, John D., *Secretary of Forest, Fish and Game Commission, Albany, N. Y.*

Whitaker, Andrew R., *Phoenixville, Pa.*

Willard, C. W., *Treasurer, Westerly, R. I.*

Worth, S. G., *Beaufort, N. C.*

The Treasurer then presented his report as follows:

To the American Fisheries Society of the United States of America.

Gentlemen:—I herewith submit my annual report as Treasurer from July 21, 1904, to July 25, 1905:

RECEIPTS.

Life membership fees	$ 75.00	
Yearly dues	389.20	
Special printing fund	50.00	
Sale of thirty-seven reports	18.50	
		$532.70

EXPENDITURES.

1904.		
July 26—Balance due Treasurer	$ 46.50	
Aug. 3—1,000 blank receipts	2.75	
Aug. 17—500 stamped envelopes	10.70	
Aug. 20—Otto P. Bahn, use of stereopticon	5.00	
Oct. 3—H. D. Goodwin, stenographer	140.00	
1905.		
Jan. 5—500 stamped envelopes	10.70	
Jan. 20—Post Publishing Co	311.95	
Jan. 20—George F. Peabody, Secretary, postage, etc.	73.83	
June 15—Typewriting letters	1.50	
July 15—Post Publishing Co	13.75	
July 15—George F. Peabody, Secretary, postage, etc.	21.64	
July 15—The J. C. Hall Co., receipt books	6.25	
	$644.57	
July 25—Balance due Treasurer		$111.87
		$644.57

Respectfully submitted,

C. W. WILLARD, Treasurer.

Motion made, seconded and unanimously carried, that the report be referred to auditing committee.

President: I will appoint as members of the committee Mr. Robert K. Robinson and Mr. N. R. Buller.

Treasurer: In addition to the formal report which I have made, I desire to state that a deficit in our treasury at this time was not unexpected by me, for the reason that our new rate of $2.00 per year will not go into effect until the present year. In January I found it necessary to advance to the society about $250 to meet maturing obligations. This shortage or deficit has been somewhat reduced by several life membership fees paid since that time. I have no doubt but that with the annual dues now raised to $2.00 we shall be able to meet all expenses during the coming year.

The following is a list of applicants for membership in the association, made since the last meeting:

Barbour, Thomas, Museum of Comparative Zoology, Cambridge, Mass. (Proposed by C. H. Townsend, Director New York Aquarium.)

Beaman, D. C., Boston Bldg., Denver, Col. (By G. F. Peabody.)

Beeson, W. E., Fire Arms, Ammunition, Fishing Tackle, (With Foster, Stevens & Co., Grand Rapids, Mich.)

Brewer, E. S., Owosso, Mich. (By Frank N. Clark.)

Brower, J. F., Torrisdale Hatchery, Holmesburg, Pa. (By W. E. Meehan.)

Buck, William O., East Orland, Me. (By G. F. Peabody.)

Burner, W. G., Durbin, W. Va. (By F. A. Degler.)

Butler, H. A., Mauch Chunk, Pa. (By W. E. Meehan.)

Clark, C. C., 306 E. South street, South Bend, Ind. (By Frank N. Clark.)

Cruickshank, James, 217 Central Park, West, New York. (By J. W. Titcomb.)

Curry, W. F., Freeland, Pa. (By W. E. Meehan.)

De Puy, Henry F., 296 West End avenue, New York. (By J. W. Titcomb.)

Donahue, L. H., Leadville, Col., U. S. Bureau of Fisheries. (By A. H. Dinsmore.)
Douglass, W. B., St. Paul, Minn. (By S. F. Fullerton.)

Fassett, H. C., U. S. Bureau of Fisheries, Washington, D. C. (By G. F. Peabody.)

Gardener, W. E., Hollidaysburg, Pa. (By W. E. Meehan.)
Gibbs, Charles, East Orland, Me. (By G. F. Peabody.)
Grindle, C. S., East Orland, Me., U. S. Bureau of Fisheries. (By A. H. Dinsmore.)

Haas, William, Corry, Pa. (By W. E. Meehan.)
Hall, C. E., Superintendent Parkside Hatchery, Cresco, Pa. (By M. G. Sellers, Secretary Pennsylvania Fish Protective Association, 420 Chestnut street, Philadelphia.)
Helmer, D. S., Post Allegheny, Pa.
Helmer, E. R., Post Allegheny, Pa.
Hempshill, T. J., Hollidaysburg, Pa. (By W. E. Meehan.)
Henkel, C. D., Bureau of Fisheries, Tupelo, Miss. (By C. P. Henkel.)
Henry, W. S., Parkside, Pa. (By W. E. Meehan.)
Hines, W. B., White Sulphur Springs, W. Va.
Irish, Clifford E., Lake George, N. Y. (By G. F. Peabody.)

Johnson, O. J., Glenwood, Minn. (By S. F. Fullerton.)

Keeseeker, A. G., Fishery, Tenn.

Lamprey, Judge Uri L., St. Paul, Minn. (By S. F. Fullerton.)

McCook, George M., Ohio Fish and Game Commission, Steubenville, O.
Marchers, George, London, O. (By Dr. Greene.)
Martin, Timothy J., Davis, Collamore & Co., Fifth avenue, New York. (By E. M. Waterhouse.)
Meeker, D. W., Moorehead, Minn. (By S. F. Fullerton.)
Miller, Walter H., U. S. Bureau of Fisheries, Spearfish, S. D. (By G. F. Peabody.)

North, Paul, Cleveland, Ohio.

Orahood, H. M., 1010 17th street, Denver, Col. (By G. F. Peabody.)

Palmer, Stephen S., Monticello, N. Y. (By E. M. Waterhouse.)

Paxton, Thomas B., Ohio Fish and Game Commission, Cincinnati, O.

Peoples, Hon. Hiram, New Providence, Pa. (By H. C. Demuth.)

Price, Andrew, Attorney-at-Law, Marlinton, W. Va. (By F. A. Degler.)

Rankin, J. H., Ohio Fish and Game Commission, South Charleston, O.

Safford, W. H., Department of Fisheries, Harrisburg, Pa. (By W. E. Meehan.)

Smith, H. G., Minneapolis, Minn. (By S. F. Fullerton.)

Snyder, J. P., U. S. Bureau of Fisheries, Spearfish, S. D. (By G. F. Peabody.)

Stevenson, Charles H., Bureau of Fisheries, Washington, D. C.

Tankerslay, A. S., Bureau of Fisheries, Tupelo, Miss. (By C. P. Henkel.)

Taylor, Robert Kirby, 66 Leonard street, New York. (By E. M. Waterhouse.)

Thompson, George B., Davis, W. Va. (By Mr. Robinson.)

Thompson, James F., Martinsburg, W. Va. (By E. M. Waterhouse.

Wolters, Charles W., Sr., Philadelphia, Pa. (By W. E. Meehan.)

Motion made, seconded and unanimously carried that the rules be suspended and that the secretary cast the ballot of the association electing the foregoing applicants.

(So done.)

The names of the members who have died since the last meeting were then read, and referred to the committee on resolutions.

President: I will appoint the following committees:

Committee on resolutions: Mr. W. E. Meehan, of Pennsylvania, chairman, Mr. Seymour Bower of Michigan, Mr. Charles H. Townsend, of New York.

Auditing Committee: Mr. Robert K. Robinson, chairman, Mr. N. R. Buller.

Committee on nominations: Mr. J. J. Hogan of Wisconsin, chairman, Mr. John D. Whish of New York, Mr. William P. Morton of Rhode Island, Mr. S. F. Fullerton of Minnesota, Mr. Frank N. Clark of Michigan.

Committee on location: Mr. Paul North of Ohio, Mr. Charles F. Brook of Maryland, Mr. John W. Titcomb of Vermont.

Mr. Frank N. Clark: I move that Article II of the constitution be amended by striking out the words "Any person shall, upon a two-thirds vote, and the payment of $15.00, become a life member of this society, and shall thereafter be exempt from all annual dues,"

And substituting in lieu thereof the following:

"Any person shall, upon a two-thirds vote, and the payment of twenty-five dollars, become a life member of this society, and shall thereafter be exempt from all annual dues."

Motion made and seconded that the amendment be adopted.

President: I am not going to make any address, because I think we have business of a great deal more importance than any word I could say to you.

An adjournment was then had to the same day and place, Tuesday, July 25th, 1905, 2:30 p. m.

AFTERNOON SESSION.

Same day and place, 3 p. m. Meeting called to order by the President.

President: I will call for the report of the secretary.

Secretary Peabody: The secretary's report for the past year is embodied in the published proceedings, and needs no further addition.

Mr. Clark: I move that the secretary's report be received and adopted, and also that the secretary be thanked for getting

out such an excellent report of our proceedings. I think it is one of the most valuable we have ever had.

Motion seconded and unanimously carried.

President: There is an old committee appointed some years ago to designate the different sizes of fish, which committee was to report at this meeting. Mr. Clark was chairman of that committee and I will call upon him for a report.

Mr. Clark: I believe that I was appointed on a committee consisting of Mr. Seymour Bower, Mr. Ravanel and myself, to consider the advisability of agreeing on a suitable nomenclature for bass of various sizes. The question has been up before the committee by correspondence since that time. There are but two members present but I desire to say that as yet we have not been able to come to any agreement on this subject.

I think the best solution of the matter is this: to call the young bass fry until the sac is absorbed. After that time until they are 30 days old call them number 1's. From 30 to 60 days number 2's, after that time number 3's. I think Mr. Bower's idea is a reversal of that plan. He would call the young bass number 3's, the middle class, or those 30 days old, or over, number 2's and 60 days or over number 1's. From that time on they are yearlings.

Mr. Ravanel wishes them called number 1's after they are 30 days old, number 2's after they are 60 days old, and number 3's after they are 90 days old. Now that is as near as the committee could get together at the present time. I think for the purpose of an easy way to get at it in distributing fish, the best way is to adopt the classification of number 1's, 2's and 3's, for 30, 60 and 90 day fish respectively. That is my idea. This idea of calling them fry, baby fingerling and fingerlings, is confusing. You cannot tell anything about them. I have up in my room small mouth bass that are not to exceed an inch long which are 56 days old. I have some there also that are 3¼ inches long that are 56 days old. They would be called, under the old nomenclature, baby fingerlings and fingerlings. I should like to hear from the others on this subject. Maybe Mr. Bower has something to say.

Mr. Seymour Bower: I thought Mr. Clark and I were go-

ing to get together before this report was made. We had talked it over a little, and there are some good reasons why the classification as he has given it to you, is all right, and there are some objections to it. Bass of the same age vary so in size that it seems to me that it is better to classify them according to size rather than age. A late hatched 30 day fish, where the water is warm, may be twice as large as one hatched early and a good deal older under different temperature and food conditions. It is a rather confusing matter, and I would like to hear from the other members of the society on this point.

President: This is a matter that ought to be settled. Of course we are all interested when we are asking the government for fish to know what to order, and what we may expect to get, and if we could settle the question here and get it into our minutes, we would be all right on that question, and I would like to hear from Mr. Titcomb on that point. He is in direct communication with the supply department, and perhaps could suggest some standard.

Mr. Titcomb: We distribute from the Bureau of Fisheries fry, fingerlings, and yearlings, so-called. We have never used the term baby fingerlings, and when we speak of a fingerling it may be a fish three months old, or it may be six months old. Of course there is a great variation in size of different species of the same age; and fingerling bass would be very much smaller than fingerling trout, perhaps. The fish have been designated as yearlings after they are six months old, you might say, although they are not nearly a year old, and that term has been applied quite as much to size as to actual age.

Now, so far as I understand the question, it is not what the applicant is going to get. We do not tell them whether we are going to give them fry or baby-fingerlings or yearlings. We have to be guided in that by the convenience of the bureau in making the distributions. We can distribute to some states in the spring of the year, and to others early in the fall; and so some are more fortunate than others. In some places we make two distributions. But it occurred to me that if we could designate fish as fry, and then afterwards as number 1, 2, 3 and 4, etc., for the number of months they have been fed after

that time, it would let one know what is being planted, so far as the fish culturist is interested in it. The outsider does not know much about it anyway, and so far as the bureau is concerned we keep a sample lot of fish distributed by each station; that is, when these fish are distributed, a sample lot of them is sent to Washington, and one can see in Washington the size of the fish distributed from the various stations of the bureau at various periods of the year. You could thus tell, under the new designation, just what number 1 or number 2 means, if the nomenclature should be adopted.

I cannot see a much clearer way to designate fish than by numbers. It is not necessary to make the reports by numbers and get it down as fine as that. You might have afterwards a general tabulation as fry, fingerlings and yearlings. As far as the public is concerned, that is enough. But when we are talking fish culture in these meetings we want to know the age rather than the size.

President: This committee has not come to any conclusion, and if there is no objection we will give them further time. Perhaps they may get on some basis on which they can report at another meeting.

We will listen to the report of the executive committee, Mr. Meehan chairman.

Mr. Meehan: There was only one matter that came before the executive committee during the year, and that was in the case of Dr. Smith, who having to make a trip to Europe suggested to the committee that he be made a representative of the American Fisheries Society to the International society, and an effort be made to have the society meet in the United States the following year. I placed myself in communication with the president of the society at once, and the necessary papers were sent to Dr. Smith. Unfortunately he did not receive them until it was too late, although there was no delay in complying with his request, but I think probably, unless I am mistaken, he had to move faster than he anticipated in the beginning. That is all that came before the committee during the year.

President: Did it put you under any embarrassment, not having your papers?

Dr. Smith: I should have been glad to serve as representative of the American Fisheries Society at the International Fisheries Congress, but as I was not provided with any official papers I could not so serve. The papers appear to have been sent to me in due time, but failed to reach me until three weeks after the congress had adjourned.

Secretary: I suggest that inasmuch as Dr. Smith was really the representative of the society, that he give us a brief account of the proceedings.

Dr. Smith: I would prefer to leave the matter until tomorrow when I will have something to say on the subject.

Dr. Smith then read a paper by Mr. Henry O'Malley, of Baker, Washington, on the subject of "Salt Solution as an Aid to Fish Culture."

Mr. John W. Titcomb then read a paper on "Progress and Experiments in Fish Culture in the Bureau of Fisheries During the Fiscal year of 1905."

Mr. Charles G. Atkins, of East Orland, Maine, then read a paper on the subject of the "Early Feeding of Salmonoid Fry."

A discussion was had in regard to the age to which brook trout lived.

Mr. John D. Whish of Albany, New York, then read a paper on the subject of "The Passing of the Native Brook Trout."

Meeting adjourned until 8:30 p. m. same day, July 25th, 1905, and place.

EVENING SESSION.

Same day and place, 8:30 p. m. Meeting called to order by the President.

President: Two years ago Mr. Titcomb visited Argentina, and last year at Atlantic City gave us an account of his explorations, but without the use of a stereopticon. Tonight he will give us some descriptive stereopticon illustrations of his trip, with comments.

Mr. John W. Titcomb delivered a lecture with stereopticon illustrations on the subject of "Reminiscences of a Trip to South America."

Dr. Barton W. Evermann exhibited slides illustrating the Golden Trout of Volcano Creek.

Adjourned until July 26th, 1905, 10 a. m., at the White Sulphur Springs Hatchery.

Wednesday, July 26.

White Sulphur Springs Hatchery, July 26th, 1905, 10 a. m. Meeting called to order by the President.

Various apparatus, consisting of fish culture appliances, were exhibited and described.

President: Gentlemen of the American Fisheries Society, it affords me a great deal of pleasure to inform you that Gov. Dawson of this state is present with us at this time. I am sure we will all appreciate his presence as a very marked courtesy to us, and we shall all remember it. It is something that we have not had before in many of our meetings, although I think we did give you the Governor in Rhode Island. We try to do things there as well as we can. (Great applause.)

Hon. William M. O. Dawson, Governor of West Virginia: Mr. President, Ladies and Gentlemen, some time ago I had a letter from our commissioner, Mr. Bowers, whom I have no doubt you all appreciate as we appreciate him in West Virginia. He is one of our own productions and you will see from his size and otherwise that we are not ashamed of him. (Laughter.) You know his reputation as a fish commissioner, you know what he has done for that branch of the service, and he has pleased the president and pleased us, which is more important to us than pleasing the president, but not quite so important to him as pleasing the president; and I am sure he has pleased all you gentlemen, who give your time, and many of your means, gratuitously, to this important business.

I say I had a letter from him some time ago telling me of this meeting; that you had honored West Virginia with hav-

ing your annual session here at this beautiful spot, the old "White Sulphur," and asking me to come and see you. I promised I would, but when the time came it was almost impossible for me to be present; but inasmuch as you gentlemen had come to our state, I wanted to meet and say to you that in behalf of our people we are very glad to have you with us; and we give you the warmest sort of southern welcome.

We are not only glad to have you with us at this time, but we hope that your session here will be so pleasant that you will come back and see us again in the future.

Now I do not know very much about the fish business. All of you individually and collectively know a great deal more about that than I do, and hence I will not undertake to lecture you about something that you know more about than I do. That would be presumption on my part. But I understand, gentlemen, that this is a very important industry. I don't know; I have not the statistics here to show what it is worth to us in dollars and cents; but it is worth something to us in other ways beside the mere intrinsic worth. Now West Virginia used to be quite a little state—not because I am Governor; it became a great state before I was Governor, and I hope it will be a greater one when I quit being Governor. That is my ambition. But West Virginia is not a small state in territory. I say to my friend in Rhode Island, that it is somewhat larger than even Rhode Island. (Laughter.) It is not quite as large as Wisconsin in territory, but states like men, are not judged from their size. I do not say this in detriment to my friend, the commissioner. (Laughter.)

Mr. Bowers: You have no business to look at me when you say that.

Gov. Dawson: Nor to my friend, the Hon. Charles F. Teeter, whom we are glad to have with us today, but I say that in defense of myself. Self-preservation is the first law of nature. West Virginia is to be judged first by the men produced, like our fish commissioner, and our senators and congressmen, and then it is to be judged by the material things it produces. United States could not get along well without West Virginia. Take West Virginia out of existence in the union and you would

have a great deal less coal, a great deal less timber, and a great deal less poultry, and a great deal less of a great many necessary things. We are in the habit of saying this, and we believe it to be true. Now it may not strike you, because you have not investigated it, but you will take the word of us who have investigated it, that we think West Virginia is the richest state in the union. Of course it is just on the eve of its development; and if any of you gentlemen are thinking of changing your location, I do not know of a better place in the world to settle than in West Virginia, and we will be glad to have you.

Now, as I said, I just came here to say a few words to you, to welcome you, and to tell you how glad we are to have you with us, to wish you a good time and to hope that you will come back and see us again as soon as you can.

I thank you gentlemen.

(Great applause.)

Dr. H. M. Smith then read a paper written by Mr. George R. Allen of Portland, Oregon, on the subject of "Notes on the Feeding of Parent Trout with Reference to Virility of Eggs Produced."

Mr. Henry Talbott of Washington, D. C., then read a paper on the subject of "Potomac Bass."

Mr. Oregon Milton Dennis, Secretary and Counsel, Maryland State Game and Fish Protection Association and Assistant State Game Warden of Baltimore, Maryland, then read a paper on "Fish Protection."

President: In our opening exercises yesterday in calling for reports of committees, Mr. Atkins was not present and I did not call for the report of the committee on foreign relations. It is a very important committee and I will call for a report from him.

Mr. Atkins: The committee of Foreign Relations beg to say that during the year they have met with some impediments and causes for delay in the work that was laid out for them; so that at the end of the year they find themselves unable to present the sort of report which they think would meet the resolution authorizing their appointment, and therefore they beg the

pardon of the society for not bringing forward a report at this time, and ask to be allowed to bring one forward at the next meeting.

(Committee continued.)

Dr. Smith then read a paper by Dr. James Henshall of Bozeman, Montana, on the "Protection of Fish in Inland Waters."

Adjourned to 2:30 p. m. same day, Wednesday, July 26, 1905, at the White Sulphur Springs.

AFTERNOON SESSION.

Wednesday, July 26th, 1905, 3 p. m., convention called to order at the hotel by the president.

Dr. Barton W. Evermann, of Washington, D. C., then spoke on the subject of the "Golden Trout of Volcano Creek."

President: We have a report from one of the committees now ready, the committee on nominations, and I will ask the secretary to read it.

The secretary read the report of the committee on nominations as follows:

Mr. President, your committee on nomination do most respectfully submit the following report:

OFFICERS, 1905.

President, C. D. Joslyn, Detroit, Mich.
Vice President, H. M. Smith, Washington, D. C.
Recording Secretary, George F. Peabody, Appleton, Wis.
Corresponding Secretary, Charles G. Atkins, East Orland, Maine.
Treasurer, C. W. Willard, Westerly, Rhode Island.

EXECUTIVE COMMITTEE.

Hon. W. E. Meehan, Chairman, Harrisburg, Pa.
John D. Whish, Albany, N. Y.
E. Hart Geer, Hadlyme, Conn.
J. A. Henshall, Bozeman, Mont.

Paul North, Cleveland, O.
J. J. Stranahan, Bullochville, Ga.
S. F. Fullerton, St. Paul, Minn.

Report of Committee on Nomination.

J. J. HOGAN,
Chairman of Committee.

Motion made, seconded and unanimously carried, that the rules be suspended, that the report be adopted; and that the secretary be instructed to cast the vote of the society for the candidates.

(So done.) (Applause.)

President (to Mr. Joslyn): I will say briefly on behalf of the society, but more on my own behalf, that I think the society is to be congratulated on your election to this honorable position. To be elected to preside over a body of scientific men, and men of wisdom and experience, is a great honor. I only regret that the rules of this body do not allow me to put you in this chair at this time; but I think Mr. Clark and others have held the chair until the end of the session, so until a year from now you will have to be considered president-elect.

Mr. Joslyn: Mr. President, I fully appreciate all that you say about the dignity and honor of the position which you now hold, and which we are all pleased to have you hold until the end of this meeting.

Last year this society did me what I considered then, and so told it, the high honor of electing me vice-president. I believe I told you then that I appreciated the character of the work of this body, and I certainly appreciate it more as I have looked into it further. It will be my endeavor, so long as I am president, to do nothing of which any one of you shall ever have the right to complain. It will be my aim to do everything I can to further the best interests of the society in every way that I know how.

This is not the time to make a speech, Mr. President, but since I am on my feet I take this occasion once for all to thank you most sincerely and earnestly for the high honor which you have conferred upon me.

(Great applause.)

President: Following the precedent of last year we should like to hear from Dr. Smith, vice-president elect.

Dr. Smith: The best thing I can say is, "Me too." President Joslyn has said everything that I have to say, and I bespeak for him the cordial support of the society. I thank you very much indeed for the honor you have conferred upon me.

(Applause.)

President: We will now resume the regular order of business. Dr. A. D. Mead of Providence, Rhode Island, has prepared a paper on "Experimental Work of the Rhode Island Commissioners of Inland Fisheries." But he has gone to Europe and Dr. Gorham has kindly, at our solicitation, volunteered to come on here and read the paper. I will say that Dr. Gorham has taken the place of Dr. Mead, and is in full charge of our Marine Laboratory during Dr. Mead's absence.

Dr. Gorham then read the paper referred to.

Mr. Frank N. Clark of Northville, Michigan, then read a paper on "Notes on Small Mouth Bass Culture at the Northville Station."

President: In regard to the question of the grading or classification of fish, I do not know but that it would be well to add to the committee that has that in charge.

Mr. Clark: I would like to move that this committee be discharged and a new committee appointed, because the three present members will never agree.

Motion seconded.

Mr. Seymour Bower: I think that motion should be carried unanimously, and in order to be relieved from duty on that committee, I will make a motion that we adopt as a standard for bass, to call them fry, after ¾ of an inch in length; ¾ to 1½ inches, call them No. 1; 1½ to 2½, No. 2; 2½ to 3, No. 3, and beyond that fingerling bass.

President: There is a motion previous to this that the committee be discharged. The motion was properly seconded and the question is before you.

Dr. Smith: It seems to me it would be unfortunate for the society to lose the benefit of all the talk and time this committee has put on this subject. Would it not be a good idea to simply enlarge the committee by the injection of some new blood, and insist on a report at the next year's meeting?

Mr. Titcomb: I second Dr. Smith's motion, which is that two more members be added to this committee and this whole question be referred again to the committee.

Motion to discharge the committee was lost.

Dr. Smith: I move that the present committee be increased to five, and that they report at the next annual meeting.

Motion seconded.

Amendment made that the committee report tomorrow.

Dr. Smith: This matter will have to be decided on arbitrary lines, and it does not seem worth while to defer this settlement indefinitely, so it may perhaps be expedient for the committee to meet and report before we adjourn, and I accept the amendment.

Dr. Smith: I will change my motion so that it will read as follows: I move that the present committee be increased by adding four new members, and that they report tomorrow.

Motion seconded and unanimously carried.

President: I will add to that committee Messrs. North. Smith, Meehan and Whish.

Mr. Clark: The chairman of that committee will call a meeting of that committee right after the conclusion of this meeting and decide what we will do.

A resolution regarding the destruction of fish was then read and referred to the committee on resolutions.

President: The programme this evening will be a five minutes talk by Dr. Smith of the United States Bureau of Fisheries on his "Observations of the Fisheries Congress at Vienna," and an illustrated lecture by Mr. A. H. Dinsmore, on the "Yellowstone Park."

A recess was here taken till 8:30 p. m., same day and place.

EVENING SESSION.

Same day and place, 8:30 p. m. Meeting called to order by the president.

Mr. A. H. Dinsmore of Leadville, Colorado, gave a lecture on "The National Park—the Great National Fishing Resort," illustrated by lantern slides.

A recess was taken until the next day, same place, 10 a. m.

Thursday, July 27.

Same place, July 27, 1905, 10 a. m. Meeting called to order by the president.

Mr. Clark called up the discussion of Dr. Henshall's paper.

Motion made, seconded and unanimusly carried, that the matter of the destruction of fish by irrigation, brought up by the paper presented by Dr. Henshall, be referred to the committee on resolutions.

Report of special committee on grading of fishes was presented by Mr. Clark as follows:

To the American Fisheries Society.

Gentlemen:—Your committee appointed to arrange, if possible, a satisfactory system for designating the various fishes propagated and distributed by the hatcheries of the several states and the United States, has unanimously agreed upon a report. It was readily apparent to the committee that any system to be generally accepted, must combine accuracy and simplicity; must retain the terms familiar to the public, and must show to the fish culturist not only the age but the size of the fish. After a careful and thorough discussion of the propositions advanced, it has been decided to recommend the following terms to be used in describing all fish:

Fry—A fish up to the time the sac is absorbed and feeding begins.

Advanced fry—A fish from the end of the fry period until it has reached the length of one inch.

Fingerlings—Fish between the length of an inch and the yearling stage. The various sizes to be designated as follows:

Fingerling 1—A fish from one inch in length up to two inches.

Fingerling 2—A fish from two inches in length up to three inches, etc.

Yearlings—Fish that are one year old but less than two years old, counting from the date of hatching, and which may also be designated as "Yearlings 1, 2, 3, etc.," according to length.

Respectfully submitted,

CLARK, SMITH,
BOWER, MEEHAN,
NORTH, WHISH,
Committee.

Motion made, seconded and unanimously carried that the report of the committee be received and that the recommendations of the committee be adopted.

President: The report of the committee on resolutions will now be received.

Chairman Meehan then presented the following resolution:

Whereas, Death was unusually busy the past year among members of the American Fisheries Society, six associates having been stricken by his chill hand, and

Whereas, It is deemed fitting to make a minute of tribute to each stricken member, the roll of which is:

Dr. J. C. Parker, *Grand Rapids, Mich.*

Hon. Horace W. Davis, *Grand Rapids, Mich.*

Dr. Rudolph Lundberg, *Inspector of Fisheries, Stockholm, Sweden.*

Capt. N. Juel, *President of the Royal Society for the development of Norwegian Fisheries, Bergen, Norway.*

Hon. Eugene G. Blackford, *New York.*

Mr. J. W. Hoxsie, *Rhode Island.*

And whereas, by the death of the above named associates the society has lost true friends and valued members, and

Whereas, Hon. Eugene G. Blackford and Dr. J. C. Parker, during their life, rendered conspicuous services in the cause of fish culture and fish protection, therefore,

Resolved, that Mr. John D. Whish of New York be requested to prepare a suitable biographical sketch of Mr. Black-

ford for publication in the proceedings of the National Fishery Society for 1905, and that Mr. C. D. Joslyn of Michigan be requested to prepare a similar sketch of Dr. Parker for the same publication; and that the two gentlemen named be requested to secure photographs of Messrs. Blackford and Parker for the secretary of the society who is authorized to publish the same with the sketches described, in the proceedings.

Unanimously adopted by a rising vote.

Mr. Meehan: The following resolution is offered by the committee, being unanimously approved by it:

Resolved, that in future all regular and special committees shall convene on the second morning of the annual meeting, at hours set previously by the respective chairmen, which will not conflict, and there shall be no regular sessions of the society that morning. Approved,

W. E. MEEHAN, Chairman,
SEYMOUR BOWER,
C. H. TOWNSEND.

Unanimously adopted.

Chairman: The following resolution was introduced and approved by the committee:

Whereas: The Hon. George M. Bowers, United States Conmmissioner of Fisheries, has, since his incumbency of his office, evinced a hearty and active interest in the aims and purposes of this society and contributed greatly to its success by making it possible for leading members of his scientific and fish cultural staff to be present at its gatherings and making public the results of their skill and experiments, and

Whereas, during his incumbency Mr. Bowers has materially expanded and improved the effectiveness of the United States Bureau of Fisheries,

Therefore, the American Fisheries Society desires to give public expression of its high appreciation of the able manner in which he has administered the duties of his office, and especially on account of the cordial relations he has established between the United States and the States in fish cultural work, and it desires also to publicly and warmly thank him for the aid and encouragement he has given the society.

Unanimously adopted amid great applause.

Mr. Bowers: I very much appreciate this token of esteem, I assure you. I believe it has been the usual custom to have published a statement showing the work of the United States Fish Commission during the preceding year. I have before me a statement of the fish and eggs distributed by the Bureau of Fisheries during the fiscal year.

I was able to have this prepared complete before leaving Washington. It is usually somewhat sooner than we are able to publish our statement, and in this instance I have not even yet submitted it to the Department of Commerce and Labor, but have given the precedence to the American Fisheries Society on this occasion.

It is as follows:

SUMMARY OF DISTRIBUTION OF FISH AND EGGS DURING THE FISCAL YEAR 1905.

Species	Eggs	Fry	Fingerlings Yearlings and Adults	Total
Catfish	.....	.....	427,402	427,402
Buffalofish	.....	.....	214,000	214,000
Shad	378,000	32,859,000	.....	33,237,000
Whitefish	60,963,000	268,405,000	.....	329,368,000
Bluefin Whitefish	380,000	1,000,000	.....	1,380,000
Lake Herring	87,040,000	35,000,000	.....	122,040,000
Quinnat Salmon	96,055,775	21,620,288	5,125	177,681,188
Silver Salmon	107,000	10 633,900	.....	10,740,900
Blueback Salmon	.....	7,819,281	10,000	7,829,281
Steelhead Trout	139,400	635,905	51,638	826,943
Rainbow Trout	301,000	442,160	345,204	1,088,364
Atlantic Salmon	8,000	727,462	289,188	1,024,650
Landlocked Salmon	192,000	275,004	130,477	597,481
Blackspotted Trout	305,000	41,205	6,388,031	6,734,236
Scotch Sea Trout	.....	.....	3,479	3,479
Loch Leven Trout	.....	27,000	2,062	29,062
Lake Trout	5,320,000	35,993,266	11,469	41,324,735
Brook Trout	756,000	8,933,881	1,087,054	10,776,935
Golden Trout	.....	157,490	269	157,759
Grayling	400,000	450,000	20	850,020
Crappie	.....	.....	850,356	850,356
Strawberry Bass	.....	.....	9,236	9,236
Rock Bass	.....	.....	48,674	48,674
Warmouth Bass	.....	.....	2,200	2,200
Small-Mouthed Black Bass	.....	.....	181,656	181,656
Large-Mouthed Black Bass	.....	.....	662,439	662,439
Bream or Sunfish	.....	.....	447,908	447,908
Pike Perch	152,750,000	246,148,775	395	398,899,170
Pike	.....	.....	62,200	62,000
Yellow Perch	5,000,000	139,452,521	326,715	144,779,236
Striped Bass	.....	2,463,000	.....	2,463,000
White Perch	700,000	23,700,000	.....	24,400,000
Tautog	.....	2,983,000	.....	2,983,000
Cod	.....	169,577,000	.....	169,577,000
Flatfish	.....	203,356,000	.....	203,356,000
Pollock	.....	8,456,000	.....	8,456,000
Lobster	.....	116,214,000	.....	116,214,000
TOTALS	410,795,175	1,337,371,138	11,557,197	1,759,723,510

I congratulate you on the success of this meeting. We have been here strictly for business. Every man has faithfully and well performed his duty.

I had prepared here a comparative statement of the total output of the Bureau of Fisheries for the years 1899 to 1905 inclusive, but modesty forbids me to present it.

I thank you for your attention. (Great applause.)

(Report received and filed.)

The report of the resolutions committee was resumed as follows:

Mr. Meehan: Mr. Chairman, the next resolution originates in the committee and naturally carries with it the approval of Commissioner Bowers, and is as follows:

Resolved, that the secretary of this society be requested to forward a copy of the following resolution to the Secretary of the Department of Commerce and Labor of the United States:

To the Hon. Secretary of the Department of Commerce and Labor.

Dear Sir: The American Fisheries Society is organized for the purpose of encouraging and expanding the work of fish culture in the United States. Among its members are nearly all the leading Fish Commissioners of the several states, and nearly all the chief Fish Culturists in the Union, including the United States Commissioner of Fisheries and his able assistants. So important are the proceedings of the Society, that the Department of Fisheries of the great commonwealth of Pennsylvania requires all its superintendents to be present at the meetings, and all the states which lead in fish cultural work regularly have representatives present.

In view of these facts it seems important and in the interest of the work of the United States Bureau of Fisheries, that the same policy as that adopted by Pennsylvania and which was first proposed by Commissioner Bowers last year with respect to his own staff, be regularly in force hereafter, and this society respectfully asks that you will give your approval thereto.

Mr. Bowers: I heartily favor that and ask that it be adopted by a rising vote.

Mr. Clark: Your remarks in regard to Pennsylvania I note. Should not some other states be included?

Mr. Meehan: The other states are properly included.

Secretary: I think it would be well, although Rhode Island is not quite as large as Pennsylvania, yet since it is quite as well and ably represented, to have that state mentioned. I think if the mention of one state is to be made, Rhode Island is certainly entitled to a place, and Michigan also.

Mr. Meehan: I think Mr. Townsend, a member of the committee has a resolution offered apart from the committee on resolutions, that has something to say in regard to Rhode Island. (Resolution reread.)

Mr. Meehan: The reason why Pennsylvania was specifically mentioned was because it has a requirement by its Department of Fisheries that all superintendents be present at these meetings, except in case of illness.

President: I think that is a grand resolution, and I think no state can take exception to it.

Unanimously adopted by a rising vote.

Mr. Meehan: The next resolution is offered by Mr. O. A. Dinsmore, and is recommended unanimously by the committee.

It is as follows:

Whereas, The waters within the Yellowstone Park are peculiarly adapted to the natural propagation of fish, and should be utilized as occasion arises by the United States Bureau of Fisheries for the purpose of securing eggs for restocking national or state hatcheries in public waters in the United States, and, whereas, under the present conditions when the superintendents of the Yellowstone Park are liable to be changed frequently, it is impossible to secure for the fish life that sustained and systematic consideration which the work requires, therefore,

Resolved, by the American Fisheries Society that the proper National authorities authorize the Bureau of Fisheries to take exclusive charge of fish and fisheries in the Yellowstone Park.

Resolved, further, that a copy of this preamble and resolution be forwarded to the Secretary of the Department of Commerce and Labor.

Mr. Meehan: The next resolution was offered by Mr. Fullerton of Minnesota, commending the efforts which have been made and being made to cede to the national government jurisdiction over the fisheries of the Great Lakes and interstate waters. This resolution is so important that the committee felt it had better be brought before the convention for full and free discussion, without formal recommendation by the committee.

Motion made and seconded to adopt the resolution.

Mr. Clark: In view of the fact that we have a paper on that line, by Mr. Joslyn, would it not be well to hold the resolution open until we hear from him? He may have some things touching directly upon the point, and the resolution might want to be added to, or something of the kind, and would there be any harm in allowing it to lie over until after his paper has been presented?

Mr. North: Why not have Mr. Joslyn's paper read now?

Mr. Meehan: The committee is still reporting, and I agree with Mr. Clark myself, that that should be the procedure, if agreeable to the Chairman and the meeting.

Mr. Bowers: I move that action on that resolution be deferred until after the reading of Mr. Joslyn's paper.

The resolution was laid on the table, to be called up at any time.

Mr. Meehan: Mr. Oregon Milton Dennis of Baltimore offers the following resolution which is approved by the committee.

Whereas, The attention of the American Fisheries Society has repeatedly been called to the rapid increase in the wholesale destruction of fish by means of illegal nets and other devices; by dynamite and by the pollution of the streams from sugar beet factories, tanneries, chemical works, wood pulp factories and other manufacturing establishments and by sawdust: and

Whereas, The American Fisheries Society regards with grave apprehension this wholesale destruction of an industry, the first value of which is upwards of seventy-five millions of dollars, and to preserve which few legislatures have taken adequate measures; and

Whereas, It is patent to this Society, that under existing conditions it is difficult for artificial propagation of fish to keep pace with this destruction; therefore, be it

Resolved, By the American Fisheries Society, assembled at White Sulphur Springs, West Virginia, this 26th day of July, 1905, that the legislatures of the several states be requested to enact such measures, without delay, as will prevent further destruction of fish life, particularly by laws forbidding the taking of undersized fish and the destruction of spawn by improper use of nets, and by legislation forbidding further pollution of the waters; and be it further

Resolved, That the Secretary of the American Fisheries Society be, and he is hereby, instructed to send a copy of this preamble and resolution to the Governor of each state with a request that he transmit the same to the legislature of his particular state when assembled.

Motion made to adopt the resolution. Seconded.

Mr. Fullerton: The protection of fish ought to go hand in hand with their propagation. It is all right for us to adopt the resolution, but every man of us should go to our different states and work, and see that the legislatures of our different states put something into practice. Last winter we had a meeting in Chicago and I do not know how many states were represented.

Mr. Clark: Seven or eight, I think.

Mr. Fullerton: We passed resolutions of the strongest kind, and went to our different legislatures to do something. I think Michigan was represented by eight or ten people. There were several members of the legislature present. The deputy speaker was there; and I expected, of course, to hear from Michigan, and that their legislature would take some action on this matter. But I have yet to see that any action was taken.

In our state the entire legislature, by unanimous vote, passed a resolution addressed to congress that they would see any jurisdiction that they might have over the great lakes, protected. We do not want to sit here and merely pass resolutions, but go home to our different states and work, and see that these resolutions are carried out. (Applause.)

Mr. Meehan: In regard to the pollution of streams, we made such a fight before the legislature this year that we compelled the manufacturers, so to speak, to sit up, and did succeed in getting a moderate anti-water-pollution measure passed; and we will succeed, I hope, in the next legislature, in getting something better, but we are suffering very much from water pollution; I think in Pennsylvania more perhaps than in most of the states; because until this time we were at the foot of the roll of states in preserving the purity of the waters of any particular state. I believe this resolution should be approved, and approved by a rising vote.

I think furthermore that the resolution itself should be given the very widest publicity, to give it all the power and force of the support of this society; and I think we should all work to secure the passage of proper protective measures in our respective legislatures.

Last year we formed a state organization and it is a pretty strong organization this year. It was so strong that it was able to effect legislation in favor of the fish; and the prospects are that it will be exceedingly powerful before long. To give an idea of the strength of that organization I may say that one measure came up last winter to which a certain senator was very much opposed, because his constituents, he claimed, were opposed to it—as he said: "The manufacturing interests." It was on the question of water pollution. Within ten days that man said: "I would like to know who said I was opposed to this measure on water pollution; I never said I was opposed to it. I want to do what my constituents say. I have had no less than 2000 letters come to me, demanding that I vote for the bill, and I am for it." It was the fish protective organizations connected with the State Society which were back of the letter-writing.

Mr. Joslyn: I want to stand up and be counted on this question. It is time, I think, that every state in the union stood up to be counted. This is not a question merely of preserving some financial or commercial industry, it is a question of preserving a cheap and healthful food for all the people of the country.

It has seemed to me, Mr. President, in view of the various troubles that our sister state New York is in, that it is pretty

near time to appoint for her a physician or a guardian, or possibly both.

It is true, Mr. President, that if we are to have fish food in the future for the common people, that we have got to go steadily along the line of protection to the fish that are planted. I shall have a little something to say hereafter, on that question, if I have an opportunity to read a paper, but it seems to me that the American Fisheries Society, which is composed of a body of men who are students and teachers throughout the country, should not be afraid to put itself on record, fairly and squarely, on this proposition. (Applause.)

President: Allow me to say one word: A resolution of this scope must invariably affect some states perhaps unfavorably. Now take my own state. If this resolution comes to me, the Governor would send for me and say. "Mr. Root, what do you want?" I would have to say, "Governor, I don't want anything." This is the action of the American Fisheries Society. It will not apply to our state. We have got all the laws for the protection of fisheries, to prevent pollution of water and everything of that kind, that we need." Now there is a case where the action of your committee would not amount to anything; but it is a small state and we can take care of it.

The trouble is, gentlemen, you have not started early enough. Each state should take hold and push this matter. Do you think this resolution will help you in pushing it? It won't help us in Rhode Island. We have the best laws that we can enact. The question is before you for adoption.

The resolution was unanimously adopted by a rising vote.

Mr. Meehan: That concludes the report of the committee on resolutions.

Mr. North: Is it in order for the report of the committee on location and time of meetings?

President: Yes.

Mr. North: The committee received applications from Denver, Colorado; Detroit, Michigan; Erie, Pennsylvania; and Grand Rapids, Michigan. But we could hardly resist the silent voice of our future president, Mr. Joslyn. Although the finan-

cial perquisites that we were expecting, did not seem to materialize (laughter) yet the committee decided in spite of that fact, to meet in Grand Rapids, Michigan, in July of next year, during a time corresponding to this week, the same days, Tuesday, Wednesday and Thursday. (Applause.)

Mr. Meehan: Although, as head of the delegation from Pennsylvania, I am disappointed in the decision, I would move the adoption of this report.

Motion seconded. (Applause.)

Unanimously carried.

Mr. Seymour Bower: As a member of the committee on resolutions I have a resolution to offer. It is not presented by the chairman, for the reason that he rather dissents from a part of it. It is a majority report, however, and although Mr. Meehan voted against a part of it, we hope that it will be adopted.

Whereas, The Hon. W. E. Meehan, Commissioner of Fisheries of the Commonwealth of Pennsylvania, during the past and present meetings of this society has contributed greatly to the interest and value of our meetings, by his zeal and devotion to its interests, and to the attendance by bringing to our annual gatherings a large delegation of his associates; therefore,

Resolved, That the sincere thanks of the society be and are tendered to him for his earnest efforts to advance the interests of the society, and we recommend him as a worthy example to be followed by the commissioners and fish cultural authorities of all other commonwealths.

Resolved, That all that has been said in commendation of the actions of Mr. Meehan is repeated in behalf of Commissioner Root and his associates of the Rhode Island Commission, and the thanks of this society are hereby tendered to the commissioners of that state.

Resolution put by Mr. Bower and unanimously adopted.

Mr. Fullerton: Mr. Bower has said that he had had prepared a comparative of the progress in egg and fish output during the last eight years, and I move that that statement of Mr. Bowers be put in to the next annual report, if he is willing.

Motion seconded and unanimously carried.

The report is as follows:

COMPARATIVE STATEMENT

Of the Total Output of the Bureau of Fisheries for the Years 1899 to 1905, Inclusive.

Year.	Eggs.	Fish.	Total.
1899	64,956,000	991,415,898	1,056,371,898
1900	88,682,000	1,075,654,754	1,164,336,754
1901	150,307,251	1,023,526,211	1,173,833,462
1902	198,672,200	1,296,871,174	1,495,543,374
1903	182,238,373	1,043,819,102	1,226,057,475
1904	263,123,354	1,004,219,671	1,267,343,025
1905	395,972,755	1,298,030,857	1,694,003,562

President: A vote of the executive committee empowering Dr. H. M. Smith to represent this society as a delegate at the International Fisheries Association in Vienna was passed, and credentials forwarded to him. He did not receive them in time to present to the Congress, but nevertheless we regard him as our delegate to that international congress. We want to hear some report from him, and I will take the liberty of calling on Dr. Smith to make a report regarding his visit to the international Congress.

Dr. H. M. Smith then presented a paper on the subject of "The Third International Fisheries Congress."

Dr. Smith's paper was referred to the committee on resolutions for the purpose of having a suitable resolution prepared regarding the acceptance by the International Fisheries Congress of the invitation to meet in the United States in 1908.

Mr. Meehan: I would like to have opportunity to express on behalf of myself and my associates my heartfelt appreciation of the resolution which was adopted by this society. It is a pleasure to me, and it is a pleasure to my associates to be present and do what we can to further the interests of this society. While the Department of Fisheries of Pennsylvania requires its superintendents to be present at these meetings, I wish to say emphatically that no order is really necessary, for there is not a superintendent in the employ of the Pennsylvania Department of Fisheries, who, I believe, would not be present of his own volition, even if he were not ordered.

(Applause.)

President: I suppose I ought to say a word in regard to Rhode Island. When we first joined the American Fisheries Society we thought of sending a delegate, or two delegates. Well, I was opposed to that, because I thought they might leave me out and I wanted to come (laughter), and I told them we would all go, and we all did. (Applause.)

The auditing committee presented the following report:

REPORT OF AUDITING COMMITTEE.

This committee has examined the accounts of the Treasurer and find the same to be correct and in accordance with his report, which is therefore approved.

ROBERT K. ROBINSON,
N. R. BULLER,
Committee.

Unanimously adopted.

Dr. Evermann then read a paper by Mr. Leon J. Cole, on the subject of "The Status of the Carp in America."

Dr. Smith then read a paper by Dr. S. P. Bartlett of Quincy, Illinois, on "Carp as seen by a Friend."

Mr. C. D. Joslyn of Detroit, Michigan, made an address on "The Policy of Ceding the Control of the Great Lakes from State to National Supervision."

Mr. Nathan R. Buller of Pleasant Mount, Pennsylvania, then read a paper on the "Propagation and Care of Yellow Perch."

Adjourned to same day and place, 2:30 p. m.

AFTERNOON SESSION.

Thursday, July 27th, 1905, 3 p. m., same place. Meeting called to order by the president.

Mr. Clark: I would like to ask leave to have the paper on "Pacific Salmon Eggs," by Mr. Ward T. Bower, printed in the proceedings without reading. Mr. Bower has been called away and cannot present his paper.

Consent given.

Mr. Clark: I move that Mr. Fullerton's resolution regarding the cession of the control of the Great Lakes fisheries to the general government, be taken from the table.

Motion seconded and carried.

Resolution reread.

Motion made and seconded that the resolution be adopted.

Mr. Meehan: I would like to ask one question before that is done. Do the efforts of Representative Shiras referred to, cover fish alone or only game?

Mr. Fullerton: I suppose everyone as well as myself has read of Representative Shiras and his efforts to get a federal law passed to protect migratory birds in their flights to the north. He switched on that during the last session and has now a bill in preparation in regard to fish. What has drawn my attention to it particularly is a discussion in the American Field, between Mr. Shiras and a California judge, as to the constitutionality of the law. But the probability is that the law is constitutional. The bill proposes that the United States take the control of the Great Lakes bordering on the states and Canada, and also on interstate waters bordering on the states, such as the Mississippi river, in which we are greatly interested, between Wisconsin and our own state, and that we may not only plant fish there, but protect them by national legislation. The purpose is to have a uniform law that fish shall only be taken in certain seasons, only be taken of a certain length, and by certain means. That is the purpose of the Shiras bill, and that is why I submit this resolution to the society here to get its endorsement, because I believe it is one of the most vital things that can come before the society, that is, the protection of the fish in our Great Lakes, and also in interstate waters. We can never get two states together, let alone forty, to pass the same laws. Minnesota may have one law regulating fish, Wisconsin another, Michigan and Iowa and the Dakotas another, and when such conditions as that exist it is pretty hard to do anything in the line of fish protection. Our only salvation is in having congress take hold of the matter, and when that is done the problem will be solved.

Mr. Joslyn: I do not like to take up any time, but while I have been away I have been thinking of that resolution a little,

and I do not know whether it is exactly right or not. I offer a suggestion to you to see what you think about it. The legal phase of this question has been sharply before us in Michigan, as many of you are aware. A little friction sprang up between the state game warden and the federal department in which the warden undertook to seize the federal men and their nets while they were out fishing for whitefish and lake trout from which to take spawn. An application was made to the Federal Court at Grand Rapids for an injunction restraining the game warden from proceeding further, the game warden claiming he had a right to do this under the state law. The United States District Court granted an injunction against the state game warden and the case is now befort the Court of Appeals. The Michigan Fish Commission realizing the serious trouble and the serious injury that was being done to Michigan by this friction, appealed to the parties to let that case wait for a while and see if we could not get legislation that would end the trouble. Last winter the legislature of the state of Michigan very promptly remedied the difficulty by giving the United States the power to take fish without the superintendence or interference of the state authorities. Now when we first talked with different members of our legislature, we found some of them had a serious prejudice against giving federal control, yet after looking the situation all over they readily came into line. And the thought that occurs to me now is whether we should not broaden this resolution sufficiently to memorialize each state legislature in regard to it and ask them voluntarily to cede the control and not leave the question open to future litigation which is sure to arise in some state if this congressional action is taken.

Now I looked into the legal question quite a bit while I was up in Michigan. My own judgment is that congress has this power. In the case of the Commonwealth of Massachusetts vs. Manchester, which arose some years ago, a portion of this very question was before that court. But the court dodged the question and it went off on some other point, but expressly reserved the question which is before us now for future consideration. It stated that inasmuch as congress had not passed any legislation it was clear that the state authorities were supreme, leaving it open for the future to see what would happen after congress had

taken just such action as is proposed by this resolution, and the action proposed by Mr. Shiras of Pennsylvania; and so thinking it all over I have wondered whether or not we ought not to broaden this resolution so as to get the state legislatures in action also. I do not offer an amendment, but offer a suggestion for you to think about.

Mr. Fullerton: I think that is in the resolution.

Mr. Clark: I do not think so.

Mr. Joslyn: I think it merely calls the matter to the attention of our members of congress, but I think we ought to get after our state legislatures.

Mr. Meehan: I think Mr. Fullerton is right.
(Resolution read.)

Mr. Joslyn: I believe that resolution is all right.

Mr. North: Would it not be well to put in there that they cede their rights as far as fishing is concerned?

Mr. Clark: It is not necessary. They have not any other rights in the waters except the fishing rights.

Mr. Meehan: I think they have.

Mr. Fullerton: Not in the Lakes. Congress regulates the commerce of the Great Lakes.

Mr. Joslyn: Within the three mile limit I think it is within the state jurisdiction.

Mr. Clark: Then there is a little loop-hole there—nothing is said about fish.

Mr. Fullerton: I am willing to have the resolution changed by inserting the words "fisheries of the" before the words "Great Lakes" where they first occur.

Mr. Worth: I would like to ask the question whether the committee that drew the resolution intended that to apply only to rivers lying between states, or to include rivers which cross a number of states?

Mr. Meehan: That would cover the Delaware and Missis-

sippi—there is no doubt about that—and I should like to see it, so far as our boundary rivers are concerned, enforced.

Mr. Fullerton: We have had a game warden in Minnesota arrested for kidnapping, by the Wisconsin authorities, which is a penitentiary offense in Wisconsin, punishable by a maximum imprisonment of fifteen years. Our warden arrested a man for fishing over an imaginary line on the ice; and they lay for the warden, arrested him, and brought him to Wisconsin and tried him for kidnapping. We had hard work to get him off.

President: If there is no objection, the words suggested will be introduced into the resolution.

Mr. Meehan: Then the resolution which we offer will read as follows:

Resolution offered by Mr. Fullerton of Minnesota, and signed for report by the resolutions committee:

Resolved, That the American Fisheries Society, assembled at White Sulphur Springs, at this thirty-fourth annual convention, wish to heartily commend the efforts that are being put forth to have the different states cede to the National Government any jurisdiction they may have over the fisheries of the Great Lakes and interstate water forming the boundary between said states. And be it further

Resolved, That this society most heartily commends the efforts of Representative Shiras of Pennsylvania in his efforts to secure the passage of a federal law regulating the fishing on the Great Lakes forming a boundary between this country and Canada. And be it further

Resolved, That this society pledges its membership individually and as a society, to get their respective Congressmen and Senators committed to the support of this measure.

The resolution was then unanimously adopted.

The committee on resolutions then presented the following supplementary report which was unanimously adopted.

Whereas, The American Fisheries Society in annual convention assembled at White Sulphur Springs, West Virginia, has learned of the action of the International Fishery Congress in

designating Washington, D. C., as the place of meeting for the next congress; therefore

Resolved, That this Society hereby expresses its gratification at the honor thus conferred on the United States by the body of distinguished foreign authorities composing the late International Fishery Congress.

Resolved, That we pledge our individual and united efforts to promote the success of the Washington Congress, and will accord all practicable assistance and support to those having charge of the arrangements.

Resolved, That at the proper time the President appoint a committee of seven members to officially represent the society at the Congress; the said delegates to represent the dlfferent geographical sections of the country as far as practicable.

Resolved, That the Society hold its regular annual meeting at Washington in 1908, in conjunction with the International Fishery Congress.

Mr. Townsend: Would the two meetings of this society be held on the same day as those of the International Congress?

Dr. Smith: It may be desirable to hold an indvidual meeting a day or two before, or it may desirable to merge your meeting with that of the greater body. A business meeting of our Society will certainly be required.

Mr. Charles H. Townsend of New York City then read a paper on the subject of "How Can the Home Fish Pond be Made Productive."

Mr. W. E. Meehan then read a paper written by Mr. S. W. Downing on the subject of "Collecting, Hatching and Distribution of the Pike-perch: Why the Great Loss of Eggs."

President: We have three more papers, one is by Mr. Worth who wishes to have it carried over to the next meeting.

The other two we will have read, and Dr. Smith has been requested to occupy your attention for a few moments on the subject of sponges.

Dr. W. E. Meehan, of Harrisburg, Pennsylvania, then read a paper on the subject of "Frog Culture."

Dr. H. M. Smith spoke on "Sponge Culture."

Mr. Joslyn: Before we adjourn, may I have a minute of the time of these gentlemen here? I desire to say in behalf of Michigan, and in behalf of the city of Grand Rapids in particular, that if you will only come there next year, bring your friends, your wives, your cousins and your aunts, and tell all the people who are interested in fish culture, whether members of this Society or men whom we desire to have members of the Society, to come to Grand Rapids, we will give you and them the time of your lives.

The city of Grand Rapids, though not my own city, I can say to you confidentially, is one of the liveliest hustling cities in the west, with a population of 125,000 inhabitants, good hotel accommodations all over the city, at any price you desire.

If you take a street car in front of almost any hotel, in twenty minutes you will reach one of the oldest, and we take pride in saying we believe the best, bass hatcheries in this country, and it is under the charge of our friend Lydell, and that is something in its favor, as you will all agree.

The managers of the two railroads have said to me that if we got the Society there, they would give us cars and a train at any hour that might desired, to take the Society to the Paris Trout Hatchery, which is our oldest trout hatchery, and we can put a train of cars at your service to go to and from that hatchery and back to the meeting. I may say to all those who come from the east, you will probably pass through the city of Detroit, and at the city of Detroit we have the fish hatchery which now is under the charge of the United States. Twenty-seven miles away we have the United States Trout and Bass Hatchery, under the charge of Mr. Clark. You can take a trolley car and in a short time reach that hatchery. We can thus give you the benefit of the hospitality of the two cities, Detroit and Grand Rapids.

In Grand Rapids is a Sportsmen's Association of over 300 men, containing such members as ex-Senator Patton, and a large number of other men like him, every one of whom has extended in writing an invitation for you to come there, and I want to say to you that that association of sportsmen will make it busy for you when you get to Grand Rapids. We want you all to come and have a good time, and we are going to undertake,

on the part of Michigan to make the next meeting of the American Fisheries Society the best on record.

(Great applause.)

Mr. Clark: May I also voice a few words in regard to the Society coming to Michigan next year? Being one of the oldest members of the Society, and possibly the oldest member present at this meeting, it does me good to think that you are coming to Michigan. There is one thing that Mr. Joslyn left out.

Mr. Joslyn: I left out a lot of things.

Mr. Clark: One thing in particular comes to my mind. He does not say anything about the world's finest trout streams which are in Michigan, so made by the work of fish planting. There are millions of trout in those streams that are longing to be caught by members of the American Fisheries Society, and on behalf of the trout in the streams of the State of Michigan I thank you for selecting Grand Rapids as the place of your next meeting.

(Applause.)

Mr. Lydell: Although Mr. Joslyn has extended to you the hospitality of Detroit, do not forget Mill Creek.

Mr. North: I move that a vote of thanks be extended to the retiring president and the officers of this Society, all of whom have worked untiringly and with great effect to promote its success.

Put by Mr. North and carried by a unanimous rising vote.

Adjourned sine die.

PART II.

SCIENTIFIC PROCEEDINGS.

SALT SOLUTION AS AN AID TO FISH CULTURE.

BY HENRY O'MALLEY, OF BAKER, WASH.

The floating properties of the salt solution first attracted my attention while using it to clear up eggs which had been removed from the spawning beds of salmon to ascertain whether or not they contained embryo. Later on the knowledge that Mr. McNaughton of Roy, Washington, had an egg-picking process for sale suggested the question: "Why cannot good and bad eggs be separated through their difference in weight?"

The first experiments were conducted with eggs of the quinnat salmon, a limited number of good and bad eggs at 450 temperature units stage of development being placed in a solution of equal parts of salt and water with the result that all the eggs floated. Water was then added and a solution of one part salt and nine parts water formed, at which point the good eggs slowly separated from the bad ones and settled to the bottom. The bad eggs remained on the top only a minute to a minute and a half, but there was ample time to remove them with a net. Later eggs of the blueback salmon were tested with similar results, but as the loss on this species is always very small, experiments were not extensive. Ten million silver salmon eggs were then tested and the greater portion of them were subject to the solution with absolutely no harm and with a great saving in time over the old method of picking eggs by hand.

In order to ascertain whether or not the salt solution is harmful, eggs at 449 and 490 temperature units developement were placed in a one to six solution and held for ten minutes. When removed they were indented, had the appearance of eggs in a shipping case that had become too dry, and in a few instances the main artery or vein seemed distended near the heart. After remaining in the water some few days, however, this distention disappeared and the eggs hatched without loss. The resulting fry did well up to the time of feeding, and when liberated they were strong and healthy. A solution one to seven was tried in the same manner with similar results. The solution one to nine was now tested and at the end of ten minutes no change had

taken place, but at the end of fifteen minutes the distended condition appeared but as in the case of the one to six solution it disappeared in a few days with no apparent harm to the fry. The eggs were subjected to the solution only once. This solution has been used with equally good results on eggs of the dog salmon and steelhead trout.

The salt solution is an aid to fishculture in other ways not previously recorded. It enables one to distinguish the dead and unfertilized eggs at an early stage of developement. To do this the basket should be immersed one minute in a one to twenty solution and then returned to the trough. Within an hour all empties will have turned white. The danger of rupturing the embryo, which is liable to occur by the old method is thus eliminated. Thus one can clean up very young eggs for shipment with very little handling.

In using this process the solution was held in a water tight box or trough of one inch lumber, 40 inches long, 18 inches wide, and 12 inches deep. Inside this was a second box of one-half inch lumber, 3 inches less in width, 3 inches deeper, and provided with handles and a screen bottom. A net or scoop made of basket wire was used for removing the dead eggs. The trough or box was filled to within a few inches of the top with water and salt gradually added and dissolved until the proper density being determined by taking a small portion of the solution in the graduate and testing it with a few good and bad eggs each time the salt was added. This was found to be the most satisfactory method, as salt readily absorbs moisture and varies in purity, thus making it difficult to get it correct by weight or measurement. The box with the screen bottom is placed in the solution, wedged down, and a full basket of from 35,000 to 60,000 eggs is poured into the inside box. In less than one minute the good eggs have settled to the bottom and the bad ones can be removed with the wire scoop. The inner box can then be lifted out and the good eggs returned to the basket and fresh water, the whole process not requiring over three minutes. One solution can be used over many times by adding sufficient salt to maintain a uniform density.

The box or trough was adopted because of convenience in handling, and on account of its furnishing the necessary amount

of surface, a very important feature to be considered, as the bad eggs if crowded, would cause the good ones to float by mingling with them.

Quite an extensive use of this method has shown no deleterious effects, and where there are over a thousand dead eggs in the basket at the time the empties are turned the use of the salt solution will result in a saving of labor.

DISCUSSION.

Mr. Whish: This is an entirely new suggestion, so far as I am concerned, and if, as suggested by Mr. Titcomb, this method can be applied to brook trout eggs, we can save much time and labor in our hatcheries. If Mr. Clark has had any practical experience with it in handling lake trout eggs, I should like to hear from him, because we have been paying particular attention to lake trout during the past two years, in our state, and will pay more attention hereafter. If we can save time and labor, it will be of great value.

Mr. Clark: I am perfectly willing to give my experience with the salt solution, as far as I have gone. I have not however, done enough to arrive at any positive, definite conclusion.

I really think it is of no value whatever so far as lake trout and brook trout are concerned, and I will give you my reasons. But still, as I say, it may be that I might change my views after another season's work with the lake trout. In order to be valuable it must do the work before the eggs are at 450 temperature units development; because at that time it would take longer to pick the eggs out of the trays in the troughs or baskets, (if you hatch them that way), and prepare, put them in the solution and wash them up, than to handle the trays and pick the eggs out. But at that time there is not one per cent of bad or unfertilized eggs in the tray. So unless this method can apply before what we call the eyed stage, with 400 and over temperature units, we cannot use it with lake trout.

I know from the experiments that we could do nothing with this method in what we call green eggs—the bad eggs would not rise. That is why I say, as far as I have gone, it is of no value to us, because after the eyed stage it will take more

time to get your eggs off the trays into the tub, pan or whatever you may have your solution in, and put them back again, than it will to handle the trays and pick out what is necessary.

With brook trout, according to our experiences, it will not work on green eggs; with the eyed eggs it is not advantageous to use the process. We get, for instance, from the commercial fisherman, 95 to 99 per cent of good eggs, as we receive them. Now it is of no value there, because those eggs can be picked out by hand quicker than you can empty them from the trays.

As I understand it, with salmon, when they are prepared for shipment, there are more or less fertilized clear eggs.

Mr. Titcomb: Yes, when you can barely see the eyespot.

Mr. Clark: As we are handling lake trout at Northville to-day, when you can barely see the eye spot, they are over 60 days old, in our colder water; and should we allow them to remain unpicked until that time all would be lost. If we can go over our eggs and have them sorted out pretty thoroughly when they are two or three weeks old, the principal work of the winter has been accomplished. Now, with our 40,000,000 lake trout eggs at Northville, had we allowed them to go until the time that the salt solution would be available, we would have one great mass of dead eggs. The salt solution method would be a saving only if we could apply it to eggs one or two weeks old. It cost us last winter probably $700 to $900 for help to sort out the dead eggs from 40,000,000 lake trout eggs. Could we use the salt solution method before the eggs had become eyed, it would be valuable.

Mr. Titcomb: Have you ever tried salting your eggs as you would salt fish, in order to avoid fungus—green eggs?

Mr. Clark: No sir. I do not think the question of fungus is anything we need bother about. I do not think you should allow these eggs to remain in the troughs on the trays, even if they have not become fungused.

Q. What is the objection?

A. I think there is something that comes off the dead eggs that should not be left in the water with the other eggs.

Q. You did not try it on brook trout?

A. We tried it on eyed brook trout.

Q. Did it work?

A. No.

Q. It would not raise the dead ones?

A. No sir.

Q. Did you try a number of solutions?

A. Yes.

Mr. Titcomb: I have seen eyed brook trout eggs come in from field stations when half of them were dead.

Mr. Clark: I am unable to see why they should be that way.

Q. You have not operated field stations with brook trout eggs, have you?

A. Oh, yes, I have.

Mr. Titcomb: Of course the conditions vary, but there are field stations where you cannot get all good eggs, I do not care how well the matter is handled.

Mr. Clark: Do I understand, Mr. Titcomb, that eyed eggs have come from the field station and 50 per cent of the eggs were dead after they were eyed?

A. No, the eggs were not dead, they were unfertilized eggs.

Q. They were white, were they?

A. They turned white in transit.

Mr. Clark: Why were they not allowed to turn before being shipped?

Mr. Titcomb: They cannot sometimes stop to do that, where they are handling millions of brook trout eggs at a field station, with probably only one man to do the work.

Mr. Clark: Of course, if there is not help enough it is a different question.

Mr. Titcomb: There is no object in it if you can take them to the main station in that way and revive them with salt solution.

Mr. Clark: Yes, if your salt solution will work.

Mr. Titcomb: I would like to see the problem worked at by different fish culturists. There must be a difference in specific gravity between live and dead brook trout eggs, just as there is between live and dead common eggs, and a test with different solutions ought to disclose a solution by the use of which the dead eggs would rise to the surface and separate themselves from the live ones.

Mr. Clark: I am not prepared to say that I have made experiments far enough in this matter to speak decisively. We should like to have the problem solved if it will help us out on the lake trout question; but with us the brook trout is a comparatively small matter. But if it won't work on the green eggs, I cannot see the value of it; unless shipments come in from the field containing unfertilized eggs, and they change their color enroute, and are ready to be removed upon arrival.

Mr. Titcomb: There is one condition that prevails in salmon work that does not prevail in the trout work. The salmon eggs all being eyed and placed in the baskets, say three inches deep, a solid mass of eggs; while Mr. Clark would have that same number of eggs in probably half a dozen trays, one on top of another.

Mr. Clark: Three trays.

Mr. Titcomb: An inch deep of eggs on each tray.

Mr. Clark: Practically, yes, aside from the size of the trays.

Mr. Titcomb: How many layers of eggs to the tray?

A. They are full.

Q. About three layers of eggs?

A. They are full, about three layers.

Mr. Ward Bower: I do not consider the use of the salt solution to be practical in the handling of quinnat salmon eggs,

judging from what I had to do with the experiments at Battle Creek station, California. I think it is of much greater importance to get better eggs so that there will be but few bad eggs to to be disposed of. A salt solution has to be absolutely correct, one to nine, or it will not work. I tried it several different days, and the first time happened to get it exactly right. The next two days it would not work with a solution supposed to be one to nine, but which upon investigation I found to be about one to nine and a quarter, and with even this would not work. The eggs should be at least 350 temperature units in development in order to make the plan of use; because they will not stand the handling much earlier. The loss would be great if they were handled at only 200 to 300 temperature units of development.

Mr. Clark: Have you tried earlier stages of the eggs; for instance, have you tried from 375 down to 300 temperature units?

Mr. Ward Bower: No sir, it was not tried with anything under 350 I think, to be exact.

Mr. Clark: And did the eye spot show then?

A. Yes.

Q. Had there been any eggs picked out previous to that?

A. They had been picked every day, with the exception of two or three days during the real critical stage of development and I consider it essential that they should be handled every day. By this course we have reduced the percentage of loss from twenty to two and one-half per cent.

Mr Titcomb: Could not you apply the salt solution right in the box, by shutting off one compartment?

Mr. Ward Bower: I do not think there would be room. Of course the hatching troughs in use there are just the plain troughs. There are no compartments in them, just plates that spring in.

Q. Sheet iron?

A. They are sheet iron. Those at the Baird station are made of steel about one-twelfth of an inch thick, but they

do not seem to be as good as those made of number 22 galvanized iron, sprung into position. In the others the steel has to drop into a slot and often sticks; while the other springs in and is much more convenient and easy to use.

Mr. Titcomb: In connection with this point on which Mr. Ward Bower has touched, the importance of attempting to fertilize as large a percentage of eggs as possible, I do not think that ought to detract at all from any attempt to make the salt solution effective, because there are certainly instances in almost every branch of fish culture, when you get a bad lot of eggs, and will have a considerable lot to pick out, or else throw the whole of them away.

PROGRESS AND EXPERIMENTS IN FISH CULTURE DURING THE PAST YEAR IN THE BUREAU OF FISHERIES.

BY JOHN W. TITCOMB, ASSISTANT IN CHARGE OF DIVISION OF FISH CULTURE.

Perhaps the most interesting and important discovery is that of Superintendent Henry O'Malley of the Baker Lake station on the Use of the Salt Solution as an Aid to Fish Culture. His paper on this subject, given elsewhere, is self explanatory.

Tests made at other salmon stations prove the value of the discovery when it becomes desirable to remove a large number of dead eggs after they have passed the more tender stages of development. For instance, all unfertilized eggs can be removed when preparing a lot for transportation in egg cases. The experiments of Superintendent Lambson as reported by him are here given:

First. Eggs of 486 temperature units development with an equal number of dead eggs were placed in a salt solution of one part salt to six parts water. Eggs showed no signs of injury the day following.

Second. Equal numbers of good and bad eggs were placed in a solution of one of salt and seven of water. All eggs remained suspended just below the surface, and no separation between the good and bad occurred. No injury to good eggs followed the immersion.

Third. Equal numbers of good and bad eggs were placed in a solution of one of salt to eight of water. After three minutes good eggs began to settle to the bottom, after five and a half minutes all good eggs had settled leaving none but dead eggs floating, these were readily poured off.

Fourth. Equal numbers of good and bad eggs were placed in a solution of one of salt to nine of water. At the end of fifteen seconds the good eggs began to settle; in two minutes none but good eggs remained at the surface, this gave best results.

Fifth. Equal numbers of good and bad eggs were placed in a

solution of one of salt to ten of water. All the good eggs and many of the dead at once settled to the bottom.

Sixth. Equal numbers of good and dead eggs were placed in a solution of one of salt to eleven of water. All promptly settled to the bottom. Eggs left in a solution of one of salt to seven of water for five minutes show a dent in the shell and feel soft and flabby as if a portion of the contents had been expelled. They resumed their normal appearance after returning to fresh water, and suffered no ill effects. Eggs remained in a one to nine solution for seven minutes without injury. Unfertilized eggs that have not turned white will settle to the bottom in a one to nine solution as promptly as the good eggs, but will turn white shortly after they are returned to fresh water; a second immersion will cause them to float when they can be readily poured or skimmed off. All good eggs used in the experiments were over four hundred temperature units of development. After eggs have passed the tender stage, over four hundred temperature units, the one to nine solution affords a cheap and easy method of removing the dead or unfertilized eggs, but until this development has been reached it cannot be successfully used as the eggs are too tender to withstand removal from the trough and pouring into the solution. It is doubtful if this method could be applied to Baird and sub-stations as eggs are picked daily through the tender stage, to avoid the collection of fungus, and practically all dead eggs are removed before good eggs have developed to a stage where they can be placed in the salt solution without injury. By picking the eggs daily we have a loss of from three to five percent; if they were buried or covered during the tender period to permit the use of the salt solution, the loss would probably be much greater from fungus. We find that the salt solution works best when not over twenty or thirty thousand are used at one time; when more than this number is used the good eggs become entangled with the dead and are thus supported at the top and cannot be separated. As we frequently put from forty to fifty thousand in a basket it was necessary to divide the basket to hold one half while the other half was in the salt solution. I can readily see the value of this method in special cases such as an injury to a basket of eggs after they have passed the tender stage which would make it necessary to remove a large

number; also in shipping should a great number of unfertilized eggs remain in the basket. The unfertilized can be removed at the time of the packing in the cases.

Experiments were made as to the value of the salt solution in handling eggs of brook trout and lake trout without satisfactory results.

Superintendent Stone opines that the differences in the specific gravity of live lake trout eggs and dead ones is not sufficient to make it practicable to separate them by the use of the salt solution, and he adds that indications seem to show that the method will succeed with brook trout eggs.

Supt. Clark is present and you will undoubtedly wish to hear him tell the results of his experiments.

Even if this labor-saving method of picking eggs is only applicable to eggs of the Pacific Coast salmon it is still of great value.

Considerable progress has been made in the past four years in the method of taking and fertilizing eggs of the Pacific coast salmon.

An important step in this direction was when the late Cloudsley Rutter discovered the use of the normal salt solution for washing eggs before being fertilized. This was found to be very beneficial in cleaning eggs which were frequently covered with blood and filth under the old method of stripping. In the year 1904 several experiments were made by the superintendent of the Clackamas station to test the efficacy of bleeding fish prior to taking the eggs and the value of this method, if any, over the use of the normal salt solution for washing them. These experiments tended to show that the normal salt solution was unnecessary but were not conclusive.

During the past year experiments have been conducted by the superintendents of the Baird, Baker lake, and Clackamas stations and the results indicate that the normal salt solution is not necessary if the fish are killed and properly bled before the eggs are taken.

The conclusions of the superintendent of the Baird station go even farther, he having decided that the quickest and best method is to kill the fish, take the eggs by incision in the thin side wall of the belly an inch or more from the fins and fertil-

ize by the dry method without washing in the normal salt solution.

The incision is made in the thin side walls of the belly about one inch or more from the fins. But a few drops of blood follow the incision and most of it runs to the tail of the fish, and does not foul the pan of eggs. The experiments of Superintendent Lambson are of such interest that they are here given.

1. From seven salmon killed by a blow on the head 30,000 eggs were taken by hand, fertilized by the dry method, and picked until shipped, the loss amounting to ten and three-fourths per cent.

2. Seven salmon were killed by a blow on the head and bled 30 seconds before spawning by cutting off the tail; 30,000 eggs were taken as soon as the blood stopped flowing, washed in the normal salt solution, fertilized by the dry method, and picked daily. The loss to the time of shipment was one and one-fifth per cent.

3. Seven salmon were killed by a blow on the head, and 15 seconds later were bled by cutting off the tail. After bleeding 30 seconds 24,000 eggs were taken by hand and fertilized by the dry method. They were picked daily until shipped, the loss amounting to two per cent.

4. Seven females were killed but not bled, 30 seconds after killing 34,000 eggs were taken from an incision in the side and washed in the normal salt solution. The eggs were fertilized by the dry method and picked daily until shipped, the loss being seven per cent.

5. From seven salmon killed and bled after the manner described in Experiment 3, 30,000 eggs were taken by incision and washed once in fresh water. Fertilization was accomplished by the dry method and the loss resulting from the daily pickings to the time of shipment was two and one-half per cent.

6. After killing and bleeding seven salmon according to Formula No. 3, 40,000 eggs were taken by incision, washed once in the normal salt solution, and fertilized by the dry method. The daily pickings of the eggs to the time of shipment amounted to four per cent.

7. From 16 females 82,000 eggs were taken by the old meth-

od of spawning while alive. They were fertilized by the dry method and picked daily until shipped, with a loss of four per cent.

The experiments demonstrated that it is useless to bleed the fish, as practically the same amount of blood followed the incision in both cases, and as it was only a few drops no harm could result were it all to mingle with the eggs in the pan. The quickest and best method is to kill the fish, take the eggs by incision in the thin side walls of the belly an inch or more from the fins, and then fertilize by the dry method without using the normal salt solution. The washing of the eggs, as described in Experiment No. 5, proved nothing, as they were not exposed to the water over half a minute before fertilizing.

Heretofore at Baird station all eggs have been taken by hand from living fish, the objections to killing before spawning being the large loss of eggs resulting from the killing of the partially ripe fish. The new method has been found to possess many advantages over the old, resulting in the saving of both time and labor, and by exercising a little care, it is possible to see that only fully ripe fish are put into the pens. It does away entirely with the butchering of the females after the regular spawning in order to obtain the few remaining eggs—a most unpleasant work, as a profusion of blood was caused by the rupture of the small blood vessels during the regular spawning, which necessitated frequent washings in the normal salt solution before fertilization could be accomplished. Another good feature of the new method is that it obviates the necessity of a skilled spawn-taker.

The season at Baird had closed before the experiments were made, but the new method was adopted exclusively at the Battle Creek and Mill Creek stations, and in addition to the time and labor saved, the quality of the eggs was improved.

The dry method of fertilization is used entirely at Baird and substations, and as soon as possible after applying the milt the eggs are washed. When there is time they are washed until the water in the pan shows no trace of milt, but if there is a large amount of spawning they are put through several changes of water only before being transferred to the spawning buckets, and in this case the water in the pan is slightly milky. The

eggs are placed in ten-gallon buckets—from 40,000 to 50,000 to a bucket—and allowed to remain absolutely quiet until they become free. This precaution is necessary, as they are very tender during the adhesive stage.

Formerly it was the custom to build the spawning and the washing platforms adjoining each other, but now the washing platform is placed at a distance from the other, and the loss in eggs ranges from five to ten per cent less.

Directions were issued to the superintendent on the Pacific Coast to examine the spawning beds of salmon, to ascertain if possible the percentage of fertilization under natural conditions. The superintendent of Baker Lake station secured 355 eggs of the blueback salmon from a spawning bed in the upper Baker River, and out of this number 51 were found to contain embryos. Later in the season he visited the same beds but was unable to secure eggs, many of the beds being covered to a depth of from one to three feet, with sand and gravel which had washed in upon them during high water and after the fish had spawned.

The reports from the superintendent of Clackamas and his assistants at the various field stations are somewhat conflicting, but the general inference is that a large percentage of eggs are fertilized and that only a small percentage hatch. Superintendent Wallich describes his observations of a male salmon in the act of emitting milt on a large spawning bed with many other salmon of both sexes. He continues by saying "The milt seems to come out like a flash and almost instantly spread out covering an area of from one half to one yard in diameter. It produced a pronounced milky hue which vanished rapidly as it floated down stream and became still further minutely divided.

Since that time I have never observed a male and female in the successful act of natural propagation, though I have observed female salmon many times in the evolutions that tend to relieve them of their eggs."

The superintendent of Baird station feels that a larger percentage of eggs were fertilized than the reports from the Clackamas station show. It is believed that the report of his observations will be of interest, and it is as follows: "The clean gravel or stones in the bottom of the creek, usually called the nest or bed, is the point where the female deposits her eggs. It

is not cleaned off prior to the deposit of the eggs but during the efforts of the fish while spawning. The gravel and small stones are also loosened at the same time and carried down stream where they form a mound or ridge a few feet below the point of deposit. This ridge probably plays a very important part in the fertilization of the eggs by causing them to collect in the water just in front. As soon as the eggs are deposited they drift down stream over the bottom and come to rest in front of the ridge. In spawning the female moves up to the place of deposit, turns on her side, and with a flopping motion ejects a portion of her eggs; she then moves off and the male takes her place and ejects a portion of his milt. By the time the milt is ejected the eggs have drifted down stream to or almost to the mound. The milt is also carried down stream and is brought to rest at the mound, where it comes in contact with the eggs. If the eggs did not collect at the ridge very few would ever come in contact with the milt, as the current would carry the milt away before it was thoroughly mixed with the water. As the female deposits but a small portion of her eggs at a time, and the spawning extends over a period of several days, each time she deposits her eggs more gravel and more sand are loosened and drift down to the mound, covering the eggs previously laid and usually killing them. Practically all the eggs on the several nests examined were just in front of the mound or ridge; some were lying in plain view upon the bottom and were picked up in small skaff nets. They were very young, still slippery, and had evidently just been deposited.

By moving the gravel in front of the ridge other eggs were uncovered, which in most cases had passed the slippery stage. Practically all of the eggs thus uncovered were dead when found, having been killed probably by the gravel washing upon them while in the tender stage or smothered by not getting a current of water. A few eggs were found behind the ridge, having evidently passed over the top.

The rate of fertilization was much better than had been expected, at least fifty per cent, but practically all were dead when found.

The small increase from natural reproduction is very likely due to the high rate of mortality after fertilization, and not to

imperfect impregnation. Eggs of widely different degrees of development were found, indicating that the place had previously been used for spawning purposes by other fish, or that they had been carried down stream from above, the former probably being the case. No indications of mating or pairing were noticed, the female spawning with any male that appeared upon the scene at the time, and the males running from one bed to another and spawning with several females. The males will fight off others that come around the spawning bed, but while he is chasing them another male will frequently spawn with her. If a female was driven from the nest she moved off a few yards and spawned in another place without making a nest, but as soon as we moved away returned to the original place. An employee of Battle Creek station states he has found eggs under two feet of gravel, all dead of course. This depth of gravel was doubtless due to high water though some of it may have been deposited by spawning fish.

The number of fry hatched from the eggs thus deposited is believed to be not over two percent."

EXPERIMENTS IN TRANSPORTING EGGS.

In connection with the Craig Brook Station, Maine, Superintendent Atkins conducted some experiments in the transportation of salmon eggs long distances in a critical stage of development. At Sebec Lake eggs of the landlocked salmon to the number of 10,000, varying in age from 6 days to 21 days, were packed upon wire hatching trays on which they were resting in the hatchery, by padding them between the trays and around them with moss so as to prevent jars, and in this way they were brought safely through to Craig Brook.

In January 1905, in a shipment of salmon eggs to the upper Penobscot, several shallow boxes were filled with eggs in masses, lying at least four deep, and no bad results followed. In one instance, such a mass of eggs lay at the bottom of the package and became frozen on the way, the bottom not being as well protected as the top and sides. Enough water had settled in among them to form a little cake of ice, in which the eggs were imbedded; such a cake of ice was kept by itself, and as it thawed it released 65 eggs. These finally hatched, every one of them, and

the loss on the fry up to the time of liberation was only five fish out of the 65. Probably, though, the eggs themselves were not actually frozen.

NOTES ON POND CULTURE.

Science has been of practical assistance to fish culture through the important pathological investigations of Mr. M. C. Marsh on fish diseases. It has been found that fish diseases are frequently due to abnormal conditions of the water supply caused by superaeration, lack of aeration, or the presence of obnoxious gasses. Reference is had more especially to the investigations of the diseases of the trout.

Another opportunity for the scientist to render practical aid to the fish culturist is in that branch termed Pond Culture. To a certain degree is involved the question of normal water aeration, in the lack of which has been found the cause of diseases among trout.

The importance of aquatic plants in pond culture and their value as oxygenators is well known. Valuable papers have been written relevant to the subject—notably one by Mr. C. K. Green at the last meeting of this society. From six to ten species of well known aquatic plants are regarded by all pond fish culturists as especially desirable. During the past two years endeavors have been made to collect specimens of all the aquatic plant life at the various pond cultural stations. The superintendents have reported the relative value of each so far as known; of what specific use the desirable ones are, and the objectionable features of the obnoxious ones. This work has developed the fact that some of the common aquatic plants are not of the same subspecies at all of the stations and the kinds of plants most valuable at one station are not so highly regarded at another. A fairly desirable plant at one station may become an obnoxious weed at another because of its dense and exuberant growth. The various subspecies of one genus are not of equal value. For example, it has just been called to my attention by Superintendent L. G. Harron that a species of myriophyllum not heretofore used in the aquarium or in fish ponds at Washington, D. C., is more desirable than the common form because it holds its foliage from the root to the top of the stem. Identification is await-

ing a blooming specimen. The plants which are valuable in pond culture are desirable for introduction into waters resorted to by the anglers. They want to know if the ponds in which they are interested are lacking in fish food, aeration, shade, etc., and what aquatic plants, if any, are respectively qualified to remedy the defect. The public as well as the fish culturists, therefore, are inquiring about such matters. The field for study is a broad one. Some plants are food producers, are valuable for shade as well, and some are especially useful for oxygenating the water. To identify all the desirable and obnoxious aquatic plants commonly found in ponds; to ascertain the specific value or objectionable qualities of each; last, but not least, to ascertain just what plants are oxygenators and to what extent, is an important work which the fish culturist must surrender to the scientist, or more specifically, to the plant physiologist.

At each of the pond culture stations records are being kept of the number of breeders to each pond and the results in the number of young fish for distribution. The object of these records is to ascertain what number of brood fish of the various species can be carried with most economical results in ponds of a given area and depth; also to ascertain of what area and depth ponds should be constructed in order to produce the best results. The experiments cannot be brought to a conclusion in one or two years, but eventually each superintendent should be able to stock his brood ponds with a knowledge of what number of fish in each will produce the most satisfactory results. The planning of future pond culture stations can be based upon the knowledge thus gained.

The use of copper as an algicide and disinfectant in water supplies, reported by Messrs. George T. Moore and Karl F. Kellerman of the United States Department of Agriculture (Bulletins 64 and 76), led them to laboratory experiments in order to ascertain the maximum amount of copper sulphate which can safely be used in water containing fish of certain species.

The matter was then taken up by the Division of Fish Culture to determine, first, whether the application of copper sulphate in proper dilutions to destroy algae would produce any deleterious effects if administered shortly before the spawning of large-mouthed black bass, as well as its effects upon minute

aquatic life upon which the young bass feed. Two small ponds at the Fish Lakes station were selected and six bass were placed in each. The sulphate in the proportion of 1 to 5,000,000 was introduced in one of them on April 22.

A roily condition of the water unaccounted for prevented observations of the nesting bass and the date of spawning could not be obtained, but on May 8 a fine brood of bass fry was discovered, proving beyond doubt that the copper did not effect the spawning of bass.

With the disintegration of the algae there appeared myriads of daphnia.

The ponds in which this experiment was tried were of too small area to rear the fry to fingerlings, and on June 12 copper sulphate 1 to 5,000,000 was applied to a pond of 1.55 acres with an average depth of twenty and three-fourths inches. This pond was inhabited by adult large-mouthed bass fry and baby fingerlings. The latter were being seined out for distribution. By June 22 much of the algae had disappeared, comparatively little remaining. Its disintegration caused the water to impart a very offensive odor when stirred. Careful observations about the pond and of the young fish seined from it daily after the copper was administered disclosed no deleterious effects upon the young fish.

The writer was assisted in these experiments by Dr. Geo. T. Moore, the discoverer of the valuable uses of copper in water supplies, and by his assistant, Karl F. Kellerman. Some laboratory tests made by them showed the following results:

Large-mouthed black bass 100 eggs uninjured by 1 to 1,000,000.

50 one-day old fry uninjured by 1 to 1,000,000.

50 five-day old fry uninjured by 1 to 1,000,000.

25 ten-day old fry uninjured by 1 to 1,000,000.

Crappie, very young fry uninjured by 1 to 1,000,000.

Fish food is an important item of expense at stations where brood fish are carried or young fish are fed for a considerable period before distribution. More or less experimental work in this direction has been conducted at all such stations of the Bureau of Fisheries, and during the past year the work has been more systematic than heretofore. The prejudice against the use

of hogs' plucks is now largely overcome, and the cost of feeding at stations where this material has been substituted for beef plucks has been greatly reduced.

At stations where fresh food is not always available there is a demand for preserved foods. It is evident that fish need nitrogenous foods. The question arises how much waste there may be in the use of cereals, and to what extent it can be avoided. In connection with the experiments on this subject it may be necessary to examine the feces of the fish, and if the waste is quite large the fact can be disclosed by the use of a low-power glass. The extensive use of wheat middlings suggests the substitution of other less expensive grains, or vegetables. A beginning has been made by experiments in the use of cotton seed meal; meal from the germ of corn; beans; lentils; macaroni. If any combination of vegetables or cereals with meat can be found which seems to agree with the fish an analysis will be made to ascertain just what elements are most satisfactory. An analysis of the mixtures which do not agree with the fish will also be made in order to ascertain just what elements should be eliminated. It is proposed to analyze preparations which have been cooked, as well as those fed without cooking, whether composed of the same ingredients or not. Dr. H. W. Wiley of the department of Agriculture has already materially assisted the Bureau in this direction.

Mention of these experiments is here made because it may suggest new ideas to the fish culturists of this Socitey which will lead to successful experimental work. The field seems to be a very broad one.

In connection with food experiments it is desirable to be able to answer certain questions rather definitely, although local conditions have much to do with the subject. For illustration, it should be possible to state the cost of feeding a given number of fish of a certain species and age during a stated period. The growth should also be noted by weight. It is realized that this necessitates a long and careful series of experiments by the isolation of certain lots of fish at a number of stations.

The report of Superintendent Atkins contains some interesting data, and it is as follows:

"With the exception of a single cow-carcass, all the food

used at the station the past year has consisted of hogs' plucks bought of J. P. Squire and Company of Boston, at prices ranging from five to nine cents per pluck, or generally five cents, making a mean cost of about one and one-fourth cents per pound, or, including freight, one and one-half cents per pound. The total purchased during the feeding season of 1904, that is, from April 2 to October 31, was 24,145 pounds. Its cost in Boston was $301.01, and, including freight, $362.21. The food given the fry has always been recorded separately from that given to the older fish. During the season of 1904 the fry under feeding numbered 543,744 of all sorts, namely:

Atlantic salmon	304,490
Landlocked salmon	2,458
Rainbow trout	1,589
Brook trout	219,783
Scotch Sea trout	6,285
Steelhead trout	9,139

Feeding began about June 1, and between that date and the end of October these fry consumed 17,871.9 pounds of food costing $307.09, or $0.000565 per fish. Thus seventeen and seven-tenths fish ate one cent's worth of food, including the freight. Reckoning on the basis of the number of fish left on hand October 1, the result would be somewhat effected, but on this basis it would still appear that not far from thirteen fish were supplied with food for one cent."

Nothing has been done during the past year with the view of increasing the natural reproduction of fish food in ponds or for the purpose of producing on a large scale, live food such as minute aquatic life and insect larvae, although the importance of this line of experiments is fully appreciated.

The importance of recording failures is sometimes quite as great as the report of successes. At several stations of the Bureau attempts have been made to propagate the spotted catfish *ictalurus punctatus* without successful results. Little is known about their spawning habits, but they apparently spawn in running water on gravel or rocky bottom. Superintendent Jones of Fishery station reports that at the World's fair in Chicago in 1893 he stripped a spotted catfish and fertilized the eggs, but the

water was so warm and muddy that the eggs fungussed and perished. It may be necessary to handle these fish the same as trout or landlocked salmon, instead of by intensive pond culture. The conditions under which catfish have been held at the various ponds have not been entirely similar, and it may be well to report them.

At Fishery, Tennessee, a brood stock were retained in a pond 200 feet by 10 feet, with a water supply of about 20 gallons per minute. The fish are said to be fat and in good condition, but have not been known to take artificial food since their arrival at the station.

At White Sulphur Springs a brood stock was received January 1905, and placed in a pond about .66 acres in area, and four and one-half feet in depth at the outlet, running about eight inches in depth in the shallow parts. The bottom is made of clay and sandy soil. The water supply varies from 25 to 75 gallons per minute. The fish appear to be in very good condition.

At Wytheville a brood stock purchased from a dealer on New River, December, 1902, were first placed in a pond of about 20 feet by 100 feet, supplied with water from a spring. In April 1903, they were transferred to two breeding ponds which had been prepared for them. One of these ponds was about 40 feet by 80 feet, with a water depth of 6 inches to 5 feet, and a gravelly clay bottom. The other pond ranged from 6 inches to 3 feet in depth, and of about the same area and a meadow loam bottom. Both ponds are nearly rectangular in shape, and had a water supply of about 60 gallons per minute. The following year the fish were all placed in one pond 60 by 110 feet, with a water depth ranging from six inches to three and one-half feet. The bottom was meadow loam with some bulrushes and other plant life in the shallow bottom. The water supply was about 70 gallons per minute. During the past season the fish were planted in a pond of about 1175 square feet in area, somewhat rectangular in shape with the water depth ranging from 6 inches to 4 feet. The bottom was chiefly meadow loam, but with solid places where the top soil was removed. The pond is well supplied with plants, and the water supply averages about 100 gallons per minute. The fish have never been known to spawn.

At the Fish Lakes station 50 spotted catfish from 12 to 16

inches in length were received in good condition last January, and were placed temporarily in a pond of comparatively small area. In April they were divided into three lots and transported to as many ponds. One lot in Pond 17, so called, succumbed to heat at a temperature of 86 degrees. None of the fish have yet been known to spawn.

APPARATUS AND EQUIPMENT.

At the various stations where eggs of the salmonidae are developed it has been observed that there is no uniformity in hatchery equipment, and for various reasons a standard width of 14 inches inside measure for hatching troughs has been adopted by the Bureau of Fisheries. It is believed that the adoption of uniform measurements in all standard equipment of trout and salmon hatcheries, whether private, state or government property, would result in a material saving in the cost of construction, and also in the operating expenses.

The adoption of a standard width for troughs is a forerunner to the establishment of uniform dimensions of hatchery trays and other equipment subject to variations made necessary by local conditions. In this connection it is observed that while asphaltum paint is used for troughs and interior equipment at a majority of fish cultural stations, there are stations where the troughs are successfully used without paint, and others where lead paint on the inside of troughs is successfully used.

Experiments are now being conducted to ascertain just what material is most practicable from a fish cultural and economical standpoint. For exposition purposes, where clear water is available, the use of bath tub enamel in wooden troughs has been found efficacious, as the fish and eggs can be more plainly seen. No deleterious effects resulted from its use.

At stations where they are not constantly in use the application of bath tub enamel on the inside bottoms of rusty transportation cans has been found efficacious. In the car service, however, where the cans are almost constantly wet, the enamel soon becomes soft. Last year 500 cans with enameled bottoms were purchased; after two or three trips the enamel softened and rubbed off. An enamel or light colored paint that will stand continual moisture would be of great value for painting the

bottoms of transportation cans, not only as a preventive of rust, but also because the bright colored bottom permits the caretaker to more easily examine the fish. For the latter reason a similar material would be valuable for hatching troughs.

LOBSTER HATCHING,

The impounding of egg-bearing lobsters on the Maine coast during the winter of 1904 was so successful that this method of increasing the collections of eggs was continued during the winter of 1905 with equally good results. On the Massachusetts coast the pound is hardly worth while with the present available supply of lobsters, but experiments were made at the Woods Hole station to ascertain the practicability of carrying berried lobsters in live cars throughout the winter. A lot of 100 lobstrs were divided equally between two cars 5′x4′x2′ 8″. The cars had wooden tops and bottoms with galvanized wire cloth for sides and ends. Up to December 20 the cars were moored on the surface in the outer basin and on that date were sunk to the bottom of the harbor, one in thirty-six feet and the other in eighteen feet of water. Another lot of 300 were placed in two floating cars 15¼′x6¼′x4′ 8″ partitioned crosswise, in the outer basin. All of them were fed regularly to the middle of December, ofter which date no food was given them until about the middle of March. Early in January a cold wave practically closed the harbor with ice and nothing more was seen of the lobsters until about the middle of March. In the basin where the 300 lobsters were placed the ice was over a foot thick during a part of this period. From the middle of March until April 20 food was supplied regularly. The two small cars which were sunk to the bottom showed a loss of about 25 per cent. On taking the lobsters from the two floating cars fifty-three were missing, and as there were no shells or other traces of them, it is possible that some of them were stolen. The experiment is therefore not entirely conclusive but was sufficiently successful to warrant furthem attempts at penning lobsters throughout another season.

In the matter of equipment for hatching lobsters there is a diversity of opinion among practical fish culturists. During the past four years the Woods Hole station has operated satisfac-

torily with open-top McDonald jars, fitted with nickel rims and over-flow spouts, the water being conducted directly from these jars into rectangular aquaria of various sizes. No change has been made in the equipment of the Gloucester station and closed top McDonald jars have been used. During the past winter the superintendent has made tests with the open-top Downing jar. This jar is unquestionably preferable to the open-top McDonald jar for the reason that there is no metal about it, which is especially objectionable with salt water. Superintendent Corliss reports that the open-top jar is just as good as the closed-top jar for hatching purposes, but complains that rectangular aquaria with open-top jars do not work satisfactorily. He has been accustomed to hold lobsters in battery jars 15″ high and 9″ in diameter, so arranged that two hatching jars empty into one battery jar and the combined force of water from these two jars keeps the contents of the battery jars in constant motion. In a large aquarium there is always dead water in some parts, and the eggs and fry collecting there are lost. In holding lobster fry it appears absolutely necessary to keep them in constant motion, in order to prevent bunching and smothering, and also to prevent cannibalism. Mr. Corliss says that another point in favor of the battery jar is its convenience, and the saving of time when putting up shipments of fry and in estimating the number of fry on hand. He states that it takes nearly three times as long to put up a shipment of lobster fry from a large aquarium as it does from battery jars. At the new lobster station at Boothbay Harbor, Maine, Superintendent Hahn has used both the open-top and the closed-top jars, and his experience is very similar to that of Superintendent Corliss. He objects to the open-top jar when used in connection with rectangular aquaria. The tests have not been brought to a conclusion, but apparently there are objectionable features to the square aquaria. These were adopted at the Woods Hole station upon the recommendation of a Special Commission for the Investigation of Lobsters and Soft Shell Clams. It is believed, however, that the Downing open-top jar or an improvement on the same will be decidedly preferable to the closed-top jar for hatching lobsters. It is less expensive than the former, and in addition has the other advantages already mentioned.

It has been customary to transport lobsters to the stations where they are to be stripped of their eggs, and then return them to the waters from which taken. In general this may be considered the best method of transporting eggs, but in order to test the efficacy of stripping the eggs from the lobsters and transporting them, Superintendent Hahn was directed to experiment with a packing case used in the transportation of trout eggs. The trays were first thoroughly soaked in salt water, and nearly 400,000 lobster eggs were then placed upon eight trays. Before placing the trays in the packing case, the bottom was covered with ice surrounded with two inches of salt water-soaked moss. Two empty trays were placed upside down on top of the ice and the trays of eggs were then added. Canvas was wrapped around the trays of eggs, and then the intervening space between the canvas and the sides of the case was filled with alternate layers of moss and crushed ice to the height of the top tray. The eggs were held by this method twenty-four hours and then taken out. They had a thoroughly dried appearance but apparently did not suffer injury. This appears to be the first time that lobster eggs have been transported on trays, and the experiment demonstrates that they can be so transported, precautions being taken to keep them at a proper temperature without permitting ice or fresh water to come in contact wih them.

THE EARLY FEEDING OF SALMONOID FRY.

BY CHARLES E. ATKINS, EAST ORLAND, ME.

The initial feeding of salmonoid fry has always been regarded by fish culturists as of critical importance and it has come to be generally considered of urgent necessity that the first manifestation of desire for food should be met promptly by its gratification. Either artificial food must be administered at once or the fry must be liberated in water affording an immediate and constant supply of natural food. Some authorities have even urged feedings in advance of the absorption of the yolk sack. The consequences of even a brief delay in this matter have been supposed to be very serious, extending to the death of all fry subjected to a few days of hunger.

At the Craig Brook station it has been one of the rules most rigidly enforced, to watch the fry approaching the completion of the sack-period very closely, anticipating their appetites by tempting bits thrown in tentatively, and to lose not a day in satisfying the first demand for food. As early however as 1897 a single experiment in fasting had indicated that the question of the soundness of the theories accepted might well be taken up, and with the hope of accumulating data from which safe rules of procedure could be formulated, several experiments in the enforced fasting of fry were undertaken in 1904, and a more extended series in 1905. It is the purpose of this paper to present the most important results obtained from the experiments of 1905.

The data which I will consider concern the treatment of 4 lots of brook trout fry, 4 of lake trout, 8 of Atlantic salmon and 4 of silver salmon, 20 lots in all, that were subjected to enforced abstinence from food; and of 3 control lots which were closely related to the fasting subjects, but were amply fed. All of these fry were hatched at Craig Brook. The feeding and fasting were conducted in troughs a little more than a foot wide, in which a depth of water of about 4 or 5 inches was maintained. The water was mainly derived from Craig pond, a lakelet of great

purity, but was mixed with spring water, the latter constituting perhaps one-third of the supply in part of the trough system and less than one-eighth part in the others. All of the fry were hatched in the supply containing the smaller proportions of spring water, and some of the experiments were begun there, but all were finally moved to the troughs fed by other mixture. The temperature ranged from 50 to 64 degrees F.

The brook trout treated were all derived from eggs received from private parties in Massachusetts, who were rearing trout for the food market, and were of inferior quality and lacking in vigor, as shown by the history of the control lot, No. 1768, out of which were taken the experimental lots, 4 in number, consisting of 1,000 fry each, A, B, C and D. On May 23, the control lot began to feed, and thenceforth received chopped hogs' liver four times daily. Lot 1768 A was not fed until 5 days later; 1768 B was compelled to wait for its first feed 9 days; 1768 C, 14 days; 1768 D, 19 days. As each of them reached the termination of its fast it was fed thenceforth like the control lot, 4 times daily. The results noted were mainly in the list of deaths, which was kept with great care to secure accuracy. The number dying was recorded daily, and for the purpose of this paper the record will be quoted from the beginning of the fast to 15 days after its close. The loss record of 1768 A, thus covered 20 days, and during that time the mortality amounted to 22, or a little more than 2 per cent. The record-period of the 9-day fasters, 1768 B, was 24 days, and the deaths therein were 60, or 6 per cent. The 14-day fasters, lot 1768 C, in 29 days lost 517, or nearly 52 per cent. The 19-day fasters, in 34 days lost 776, or nearly 78 per cent. Thus it would appear that in this series, the losses were severer the longer the fast, and in the case of the longest fast the loss approached annihilation.

Let us now see how these losses compared with those suffered by the control lot, which had been fed constantly from the start, 4 times daily. Comparing the latter with the 5-day fasters (1768 A) the control lot lost four and four-tenths per cent while the fasters were losing two and two-tenths per cent, that is, if these results be attributed wholly to the food, the generous feeding doubled the mortality. Compared with the 9-day fasters

the control lot seems to have reaped a slight advantage from the food eaten, having lost but four and nine-tenths per cent, while the fasters were losing six per cent. When we next compare the eaters with the 14-day fasters, we find the advantage very decidedly in favor of the food; the eaters have lost but five and four-tenths per cent, while the fasters were losing 52 per cent; finally, the victims of the 19-day fast lost 78 per cent, while the eaters were losing 6 per cent.

Whether trout fry of prime condition, from vigorous wild parents, would have suffered as severely as those treated in these experiments is a question we have no means of answering positively; but the presumption favors a negative answer.

The next series of experiments to be considered deals with lake trout fry. Of these there were four lots, of 100 fry each, and their fasts, as in the case of the trout, were, respectively, 5, 9, 14 and 19 days, but in each case the fry had been fed 6 days before the fast began. Accounting in each case for the losses from the beginning of the fast down to 15 days after its close, it appeared that the mortality was a little heavier than with brook trout in the cases of the fry fasting 5 and 9 days, and a little lighter in cases of the longer fasts. There was no control lot of lake trout.

Of Atlantic salmon fry there were two series. The first series embraced 4 lots, of 1,000 each (marked 1847 A, B, C and D), and their fasts were, respectively, for 5, 10, 15 and 20 days. None of them had received any food before the experiments began. The total losses for periods corresponding with the computations for the brook and lake trout, that is, from the beginning of the fast down to 15 days after its close, were respectively, 25, 43, 64 and 217 fry out of each thousand—the percentages being thus two and five-tenths, four and three-tenths, six and four-tenths and twenty-one and seven-tenths.

The second series of Atlantic salmon fasters consisted of four lots of 500 each, from the same control lot as the first series, namely, No. 1847, and the members of this series were distinguished by the letters E, F, G and H. Their losses for similar periods as the other series were, respectively, in percentages, four-tenths, eight-tenths, six and six-tenths and fourteen and six-tenths. As compared with the first series, these were lighter

losses except in case of the 15-day fasts, where it was almost exactly the same. The mean losses of all the lots of the first series were eight and seven-tenths per cent, and of the second series five and six-tenths per cent, a difference of three and one-tenth per cent in favor of the second series. As these fry, both series, were taken out of the same original lot, the difference suggests the query whether there was any difference in the treatment of the two series. There was a difference, which I will now state, without, however, claiming that it explains the difference in results.

It had occurred to the experimenter that fry that were denied artificial food might still be able to pick up a trifle of food in the form of minute animal life brought in with the water-supply, to tide them over the waiting period. In order to eliminate this source of uncertainty, one series of the Atlantic salmon fasters was kept in water filtered through gravel and sand which must have intercepted most, perhaps not all, natural food. Now did the fry so treated show any effect of being deprived of an equal opportunity to snatch a possible bite of live food now and then? On the contrary, the fry so rigorously treated had lighter losses than those in unfiltered water. The general summary for the series in unfiltered water show a loss of eight and seven-tenths per cent, for those in the filtered water five and six-tenths per cent, a difference of three and one-tenth per cent in favor of the filtered water.

Now how do the losses of the fasters compare with those of the control lot from which they were taken and which had been fed 4 times a day? As in the case of the brook trout the five day fasts were accompanied in each series of fasters by a lighter loss than in the fish that were fed. The 10-day fast of the first series was accompanied by a little heavier, and that of the second series by a very much lighter loss than in the control.

The facts already stated are certainly surprising, but the most astonishing part of this experience is still to be laid before you. It pertains to the experiment with silver salmon. [Oncorhynchus Kisutch] This Pacific species the station has handled this year for the first time. For the fasting experiment 4 lots of them were counted out, 500 fry in each. They were ready to feed May 18, and on that day the feeding of the control lot began, at

the rate of 4 feeds per day of chopped hogs' liver. The fasts were for 5 days, 10 days, 14 days and 19 days. The losses of the first three lots for the usual period, that is, from the beginning of the fast down to 15 days after its close, were exactly alike, 8 fish dying out of each lot, a percentage, for the entire period, of one and six-tenths. The lot that fasted 19 days lost—in 34 days just 6 fry, a percentage of one and two-tenths. Comparing now the 4 lots with each other and stating the losses in the ratio of the daily losses per 10,000, the fasters for 5 days lost 8; the fasters for 9 days lost six and four-tenths; the fasters for 14 days lost five and one-half; the fasters for 19 days lost three and one-half; eight, six and four-tenths, five and one-half and three and one-half. That is, the longer the fry fasted the lighter the mortality. Comparing now the fasters with the control lot it is found that the latter, the feeders, lost at the rate, stated in daily loss per 10,000, for the different periods, 13; ten and four-tenths; nine; and seven and seven-tenths. A mean of these losses would be 10 daily out of 10,000 or one-tenth of one per cent, while the mean loss of the fasters was five and eight-tenths daily out of 10,000, or one-seventeenth of one per cent. That is, taken all together, the feeders lost almost twice as heavily as the fasters.

To sum up for all the species except lake trout, the 5-day fasts were in all cases accompanied by lighter mortality than that suffered by the feeding fish; the 9 and 10-day fasts by lighter mortality in some cases, by heavier in others; the 14 to 20-day fasts by heavier mortality except in the case of silver salmon.

The subsequent behavior of the fry deserves a moment's mention. The fry appeared, during the extended fast, to grow thinner in body, but when feeding began they were in every case ready, at once took to eating and in a few days showed that they were building up.

What practical lessons are to be drawn? Far be it from me to insist that this series of experiments be taken as concluding the matter. It is only one series, and needs support from others. Yet the results agree in general with those obtained in 1904 and earlier, at the Craig Brook Station, and surely indicate that an early and abundant supply of food is by no means so essential to trout and salmon fry as we have supposed. They even go

further and open the question whether feeding at the initial stage has not ben overdone in the past, both as to time and quantity. Possibly it might be better to wait a few days longer or to limit the quantity or frequency. But these are questions that should be very carefully investigated, and I urge the study of the matter upon all fish-culturists.

TABULAR STATEMENT OF FASTING EXPERIMENTS.

LOT MARK	SPECIES	PREVIOUS TREATMENT	FAST			RECORD OF LOSSES		Census at Start	DEATHS		
			Begins	Ends	Length Days	Ends	No. of Days		Whole Term		Daily per 10,000
									Count	Per ct.	
1847 A.....	Atl. Salmon.....	No food....	June 4.....	June 8.....	5	June 23.....	20	1,000	25	2.5	12
1847 B.....	Atl. Salmon.....	No food....	June 4.....	June 13.....	10	June 28.....	25	1,000	43	4.3	17
1847 C.....	Atl. Salmon.....	No food....	June 4.....	June 18.....	15	July 3.....	30	1,000	64	6.4	21
1847 D.....	Atl. Salmon.....	No food....	June 4.....	June 23.....	20	July 8.....	35	1,000	217	21.7	62
1847 E.....	Atl. Salmon.....	No food....	June 4.....	June 8.....	5	June 23.....	20	500	2	0.4	2
1847 F.....	Atl. Salmon.....	No food....	June 4.....	June 13.....	10	June 28.....	25	500	4	0.8	3.2
1847 G.....	Atl. Salmon.....	No food....	June 4.....	June 18.....	15	July 3.....	30	500	33	6.6	22
1847 H.....	Atl. Salmon.....	No food....	June 4.....	June 23.....	20	July 8.....	35	500	73	14.6	42
1847.....	Control lot.....	No food....	No	Fast	.....	July 8.....	35	15,010	646	4.3	12
1768 A.....	Brook trout.....	No food....	May 23.....	May 27.....	5	June 12.....	20	1,000	22	2.2	11
1768 B.....	Brook trout.....	No food....	May 23.....	May 31.....	9	June 16.....	24	1,000	60	6	25
1768 C.....	Brook trout.....	No food....	May 23.....	June 5.....	14	June 20.....	29	1,000	517	51.7	177
1768 D.....	Brook trout.....	No food....	May 23.....	June 10.....	19	June 25.....	34	1,000	776	77.6	228
1768.....	Control lot.....	No food....	No	Fast	.....	June 25.....	34	15,438	936	6.1	17.9
1747 A.....	Lake trout.....	Fed 6 days..	May 23.....	May 27.....	5	June 11.....	20	100	3	3	15
1747 B.....	Lake trout.....	Fed 6 days..	May 23.....	May 31.....	9	June 15.....	24	100	9	9	38
1747 C.....	Lake trout.....	Fed 6 days..	May 23.....	June 5.....	14	June 20.....	29	100	42	42	145
1748 D.....	Lake trout.....	Fed 6 days..	May 23.....	June 10.....	19	June 25.....	34	100	72	72	212
1832 A1.....	Silver salmon	No food....	May 18.....	May 22.....	5	June 6.....	20	500	8	1.6	8
1832 A2.....	Silver salmon	No food....	May 18.....	May 27.....	10	June 11.....	25	500	8	1.6	6.4
2832 A3.....	Silver salmon	No food....	May 18.....	May 31.....	14	June 15.....	29	500	8	1.6	5.5
1832 A4.....	Silver salmon	No food....	May 18,....	June 5.....	19	June 20.....	34	500	6	1.2	3.5
1832 A.....	Control lot.....	No food....	No	Fast	.....	June 20.....	34	500	13	2.6	7.7

DISCUSSION.

President: Perhaps there are some gentlemen here who have had experience in the same line, and who would like to make some remarks on the question. We should be glad to hear from them if they have.

Mr. Titcomb: How do you determine the actual number of days that have passed, so as to know when to begin reckoning the period of testing and feeding?

Mr. Atkins: We carefully watched the fish, and whenever the general lot was ready to feed then we reckoned that the fasting began. For instance, the control lots were taken out of the same original lots as the fasters, so they were all originally the same lot of eggs. One section would be set out to be fed and another to fast. Those that were set out to be fed would be tried carefully, and the regular feeding begun the moment they began to take food, and from that time on we began to take our records.

Mr. Clark: These accurate experiments noted down are very important. If conclusive, we need not hurry out our fry, as I have done for many years, for I have always made it a point to distribute fry before the sac was entirely gone. We were afraid that otherwise the fish would begin to starve before they found their natural food. At the present time most of the people distributing fish go on that plan; they try to get them out as fry before the sac is entirely gone, because they are afraid that otherwise the fish will starve. But, Mr. Atkins, even with our feeding as we do now, that is, putting our fish in the feeding trough before the sac is gone, we still find from two per cent to five or ten per cent that starve and drift down to the screen. Now, do you think that they are starving, or are they simply weak fish? Did you make a note in your experiments as to any such weak fish?

Mr. Atkins: While the lost are all recorded, although I did not personally look into the trough to see whether the fish were up at the head of the trough, or down at the foot, and did not ask any questions about it, I presume, as is usually the case, that most of the dead fish were found at the lower end of the

trough, and that they were probably weaklings. Why they were weaklings I think is an open question; but I am more inclined than ever, after these experiments, to think that the weakness must have been originally with the fish, and was not because they were lacking food or had failed to get their share, and that they would have died anyway. In fact, as was seen in general, we found that the fish that were fed liberally, lost more during the short periods, five and ten days, than those that had no food given them at all. So I think that the probability is, that when we are able to investigate that question very closely, we shall find that the cause of the death of those fish is generally something besides lack of food.

Mr. Clark: Do you now think from these experiments, that you will feel warranted in not hurrying to get your fry out? I take it for granted that you have been distributing fry and that the aim has been to get them out before they were too old.

A. Yes.

Q. And now do you think that you will be warranted in taking more time, if necessary, and not hurrying?

A. Well yes. I think we will be warranted in taking more time; but I would not like that series of experiments to be taken as conclusive. We must keep trying, and I hope to be able to try the experiment more extensively another season. I shall now dare to experiment with a larger number of fish than I did before, and possibly I will feel a great deal surer of my ground another season than I do now.

Mr. Dinsmore: I would like to ask if, in the case of the fish in the controlled lots, the base on which the percentage was reckoned was the same as in the experimental lots; that is to say, whether in the controlled lots you had more fish in the troughs than in the experimental lots. I did not catch the point.

A. No, I have a tabulated statement that will answer that question. In the case of the first series of Atlantic salmon there were 1000 in each case, in the first series of the experimenting; and there were 500 in each of the four of the second series of experiments; and the control lot was a larger lot containing 15,000, and was held in quite a number of troughs. I cannot state how much room, comparatively, those fish had, but in the

case of the brook trout, the number of brook trout in the control lot was very large. In the case of the silver salmon the control lot was just the same size as the experimental lots, 500 in each lot, and they had the same room. And the performance of the fish that were fasting was much above those that were fed.

Mr. Talbott: It seems to me that it would be of some interest to know what the final effect on those trout might be. I know more about pigs than the raising of fish, and a pig ill-fed in its early months becomes permanently stunted. Is there no fear that starving the trout will so stunt the fish that it will never reach the size that it would otherwise reach at maturity?

Mr. Atkins: I think there is good ground for suspecting that it will have that effect. The experiments of 1904 were made in June and July, but I intended to carry all the fish experimented with, through to October, and then to weigh the different lots very carefully, and see which had gained the most, and how much the fasters had suffered in their growth during the season; but unfortuately the troughs were little experimental affairs, standing side by side, and were not guarded against each other; and too many fish jumped over from one to another and got mixed up, so that I could not rely on the results. This year, however, those lots are all to be carefully kept separate, and in October I shall weigh them all and then be able to answer that question. But to the eye they seem to be keeping up well, and we hope that even in the case of the longest fast, the fish will be pretty good fish when fall comes. Of course I do not wish to be understood as claiming that there is any likelihood of our finding any advantage in keeping fish fasting 19 or 20 days — I do not expect that. I do not even expect that we shall find that it is any better for them to fast ten days; and perhaps it would not be quite so good on the whole, but I do think that there is a great probability of its proving finally that there is no particular hurry about turning the fish out in the beginning, and if it is desirable for any reason to interrupt feeding 1, 2, 3 or 4 days, we need not fear any untoward results from the interruption. It may be necessary in case of the attack of some disease to put a group of fish on a limited diet, or have them go without food for a number of days; and if such experiments in

the future lead to similar results as these that I have reported, then we should feel quite safe to do such things.

Mr. Clark: I think Mr. Atkins has stated in his discussion that in 1904 the fish became mixed.

A. Yes.

Mr. Clark: That was the first time we heard you say anything about 1904. In the paper you did not give us those figures.

Mr. Atkins: I mentioned the fact that I tried it in 1904.

Q. Did you find the percentages run the same in 1904 as in 1905?

A. Yes, about the same.

Mr. Marsh: Was every remnant of the sac in the 19 day lot absorbed before the period of fasting began?

A. Yes.

Mr. Dean: This last spring we took a lot of 1,000 trout up to the spring to test the water; it was over 2 miles up there, and we could not feed the fish more than once a day; but they did as well or better than those fish that had been left in the hatchery. But in taking out fish for experiments, oftentimes we take them out of a lot of fish, and necessarily dip out the best ones; and you leave the inferior fish in the trough for control; as far as percentage went, those that went to the spring did better than those that were left in the trough. When there are a lot of fish in a trough, the weaker ones go to the lower end, and you usually go to the head of the trough to dip out fish for experiments, and thus get a superior lot.

Mr. Atkins: I thought of that point after the experiments had been concluded, and I asked my foreman, who had direct charge of the matter, whether he tried to select the best fish, or whether he tried to select just a fair average of them, and he told me that he tried to avoid selecting the best fish but to make a fair average. His effort was in that direction; but of course it is quite possible that unintentionally the men who

counted those fish out, did get rather better than the average. In fact it would not surprise me, if that turned out to be exactly the case.

Mr. Dean: That is what I mean: you do not intentionally do so, but cannot help it, because in dipping up, the weak fish will not get into your nets.

Mr. Atkins: I am hardly ready to accept that theory. I think the weak fish will get into the net as readily as the good ones.

Mr. Dean: Yes, if you went clear to the bottom you would get the weak fish, but if you just simply get the fish from the top of the trough, you will get the stronger and hardier specimens.

Mr. Atkins: In our way of handling we go to the bottom every time. We dip up fish with nets with flat fronts. The water is only five inches deep and we dip clear to the bottom of the troughs every time.

Mr. Clark: Would it not be better for Mr. Atkins if he makes a similar experiment another year, to go further back than the fry when they are swimming up, and take a tray, say of 5000 eggs, for your control lot, and a tray of eggs for your different fasting lots. Then you will have the weak and strong all together. Then I think you would come nearer a correct result than by the present method.

Mr. Atkins: Yes, if you are quite sure your eggs are alike on the different trays; and I think it would be well worth while to begin with the eggs, instead of waiting for the fry.

Mr. Clark: Start after your eggs are eyed.

Mr. Titcomb: In your observations or experiments, have you observed that fry do not take any food whatever until the sac is entirely absorbed?

Mr. Atkins: I have not observed. I have not studied them in that direction enough to say.

Mr. Clark: I have seen them take it before the sac was gone.

Mr. Atkins: I think I have seen that thing happen. It will snap at it at any rate.

Mr. Clark: I have seen them take liver.

Mr. Titcomb: It has been quite customary, and believed to be desirable at many stations to begin to feed fry before the sac is absorbed, sometimes giving them nothing but blood. But in this case I wondered just how you knew when the sac was entirely absorbed. I thought you judged the fasting period as against the feeding period by the time the fish began to take food rather than as to whether the sac was entirely absorbed or not.

Mr. Atkins: You are correct. We go rather by the indication of the fish as to whether they want food than by actual examination, to determine the absorption of the sac. Those have been my instructions to my assistants, to try the fish, and whenever they are ready for food to give it to them. But in general it can be said that we began about the time the sac was absorbed. I do not think that in case of our fish there has been any general anticipation of the absorption of the sac in their taking food, although not having studied that point very closely I would not like to be certain of the absolute correctness of the statement.

Mr. Titcomb: Then if the trout, in your experiments, came up to take food a little before the sac was absorbed, this experiment may have been begun a little before the sac was absorbed?

A. It is possible.

Secretary: There are some communications from members asking questions in regard to trout, this being the subject under discussion.

I have received with the following report a letter containing a question which is as follows:

"There is one question, recently called to my attention, in relation to fish culture, which I should be very much pleased to have discussed by the society.

I am President of the Grand Mesa Lake and Park Company, the proprietor of 13 large lakes on the Grand Mesa in Colorado,

which contain a very great many native mountain trout. These lakes are under lease to the United States government for the purpose of permitting the United States Fish Commission to take therefrom spawn for government use in propagation. The present superintendent of the hatchery claims to me that the large male trout in the lakes are very destructive to the fry, a portion of which are each year returned to the lakes by the Fish Commissioner, and advises that a large number of these males as stripped be not returned to the lakes, but marketed.

This is the first time I ever heard that the male native trout are more cannibalistic than the female, or that the native trout was essentially cannibalistic, except where other food was scarce. Other food being abundant in these lakes I have never supposed that the fry were suffering in that way.

Yours truly,
D. C. BEAMAN."

Another gentleman asks, to what age do brook trout attain?

President: I think this society ought to have some members able to answer almost any sensible question in regard to trout, and I hope that we shall hear from some one.

Secretary: I should like to hear Mr. Titcomb's opinion on both these questions.

Mr. Titcomb: I have heard a great many stories about trout living to a great age, enclosed in spring holes, where they have very little food, but had water of a perfect quality and absolute aeration probably; and they did not attain large size. I would not want to say how many years they would live under those conditions. I do not think that we are capable of judging of the age of trout at all by those we keep in our hatcheries under domestication.

Mr. Meehan: We have had brook trout live in our hatcheries about 24 years, the males living longer than the females. We find too, that as a rule in our hatchery ponds, the trout do not attain the same size and weight as those that may be caught in the streams. I have a record at my office this year of something like 30 brook trout (that is the charr), caught in Pennsylvania waters, that will run from three and one half to four pounds,

and one or two a little over four pounds. We have never had any of that weight in our ponds.

We have had California trout for fourteen or fifteen years, and in that case the female seemed to have greater vitality than the male, and lived longer. We had a few specimens of the California trout which we carried through to that age, and in each case the female ceased to spawn at about twelve years. At our Corry hatchery they thrived better than at some other hatcheries.

We have some lake trout in our ponds that were there nearly thirty years ago, and were young fish at that time.

Secretary: It is strange but true that there seems to be no data giving the age of trout.

Mr. Dinsmore: I have been waiting for some one to speak of the cannibalistic nature of the black spotted trout. I will not make positive statements, but I have frequently found black spotted male trout so gorged with eggs, that I have taken them off the beds and attempted to strip them for females.

In connection with these very lakes about which the gentleman has asked a question, I came from them last Monday, and just below the troughs where we were eyeing the eggs over into the lake, and there the big schools of black spotted trout were eager to pick them up. I presume they would have picked them up just the same if they had been live eggs.

Mr. Titcomb: I can answer that question, about the cannibalistic nature of the trout, or the tendency of the male trout to eat the eggs of the females. I observed one small bed under a rock in a lake in Canada, where a person could look down and see the performance of the fish. Twenty-seven trout were taken off this spawning bed, although there were but two females which were in spawning condition, a few spent females, and the balance were males which were there eating the eggs as fast as they came from the female.

Mr. Hubbard: Did you not observe the female eating the eggs as well as the males?

Mr. Hubbard: Yes, the spent females.

Q. And would not some of the females eat their own eggs after spawning? I have seen brook trout do that.

A. Yes, sir, I understand that is an accepted fact.

THE PASSING OF THE NATIVE BROOK TROUT.

BY JOHN D. WHISH, OF ALBANY, NEW YORK.

Mr. President: I should like to introduce my paper by presenting these few verses which seem to me to be interesting and appropriate.

"Where do I get some trout to-day?"
Asked the fisherman, blithe and gay.
The boy looked shy, but he made reply:
"You don't catch any this way.
There aint no trout, not hereabout
Where the big ones used to be,
And I guess, if you look at the old trout brook,
You'll understand why," said he.
"There's a pulp mill up on the river,
And a tannery further down,
And the fellows that look at the old trout brook
Just hustle right back to town."

It is the object of this brief paper to state the fact, express a belief and cause if possible, helpful discussion.

My proposition is that the native brook trout, commonly called "the old fashioned speckled trout," and scientifically known as the Salvelinus Fontinalis, is doomed to become extinct, and is even now passing away. My remarks are applied to New York state, but there is ample reason to believe that they will apply also to several other states.

This matter has been brought to my attention by letters passing through my hands as secretary of the New York State Commission, and by remarks of fishermen returning year after year from their favorite waters. It is presented at this time, not as anything particularly new or startling, but for the purpose of making the fact a matter of record, and for the more particular purpose of getting the society to discuss the proposition along particular lines and with special reference to trout diseases.

The destruction of wild things is nothing new, however regrettable it may be. The American Indian has passed away

before the march of civilization; the buffalo which he hunted on the great plains is gone; the wild pigeon of our woods is no longer seen; the coarser shad no longer ascends our rivers; and why should not the brook trout be a like victim of circumstances? We may not like to admit it, but is it not a fact?

In thinking this matter over, I am surprised that the brook trout has not long since disappeared. I honestly believe it would have so vanished had it not been for the millions of artificially raised fish which the Commissions of the several states have carefully planted each year for many years past. Look at the situation as it exists with us in New York alone. The forests which once clothed the Adirondacks and the Catskills have in part disappeared. As a result, the volume of flow in our streams has dwindled away, the water has become warm, and the natural food of the trout must have to a great extent disappeared. More than this, our water courses are in many cases no longer undefiled. They carry the nameless pollution of civilization. In the Adirondacks they have had the outpourings of tanneries, saw mills, and (most deadly of all) of paper mills. In the Catskills, in addition, they are occasionally getting the refuse of cheese factories. In each case they are no longer fit water for trout. Further, there has been a steady increase in number of detrimental fish in our trout waters,—not necessarily undesirable fish, for sometimes in the Adirondack lakes it is the bass; but there is no denying the fact that the carp and the suckers and other spawn eaters have made great advances in numbers in recent years.

Also there is another and very serious danger confronting the brook trout, in my judgment, and to this particularly let me call your attention. I refer to what are called "parasites" and to the diseases due to their increase. A year ago I reported to the Society a remarkably fatal epidemic among our brook trout at the Cold Spring Harbor hatchery, which also effected the large private preserves in other parts of Long Island. We had prompt aid from Commissioner Bowers at the time, and the disease was carefully studied by Mr. Marsh of his expert staff, but beyond his careful study of the disease, we thus far know nothing. Yes, we do know that it has recurred, and that it has again destroyed all the adult fish there and elsewhere in the

vicinity. It therefore seems to me that the time has come for the men interested in fish culture, and particularly in trout culture, to get together and aid each other, if so they may. Because, if we can no longer keep stock fish in our hatcheries, the day of the brook trout is being hastened faster than most people suppose.

Nor is this dreadful disease the only thing of the kind acting toward the extinction of the brook trout. I mean to speak frankly in the hope that others will also. The parasites that kill are increasing yearly in our waters. We cannot keep stock fish (brook trout) in any of our hatcheries. The Adirondack hatchery supplied by Lake Clear; the Caledonia hatchery with its magnificient water supply from an underground river; Cold Spring which has already been mentioned; the Catskill mountain hatchery known as the "Delaware or Margaretville," not to mention the hatcheries at Pleasant Valley and on the Fulton Chain, are out of business so far as keeping a stock of fish on hand from which to take eggs is concerned. At the Adirondack and the Caledonia hatcheries in particular, where the water supply is both clean and cold at all times, we have a form of parasite that is known to you all. It seems to effect the brook trout only and is commonly known as the "fish louse." Scientific men who have examined fish seriously effected say we are suffering from an unusual number of a copepod which they call the Lernaepododa Salmonea Linnaeus. They say also that it is common in the west and east and that when it exists in large numbers it "seriously affects" the trout. This is an easy way to put it. The fact is that it kills the fish.

Now the serious aspect of this case with us is found in the fact that this parasite is steadily increasing and has invaded nearly, if not all, the waters of the western Adirondacks. Thus far the waters of the eastern side of the Adirondacks seem to be but slightly affected. We have been very careful for years about distributing our trout, so as not to help spread the pest, but it has increased in spite of everything. It is not any longer confined to the water feeding hatcheries; it has invaded the mountain lakes. The best advice we can get is given by an eminent scientific man in these words: "No method has been found of getting rid of the adult parasite, but in the early stages it can

be destroyed by introducing small fish that feed at or near the surface of the water and freely eat the larvæ of the parasite swimming there." He recommends to us the fresh water killy, sometimes called the grayback.

I believe that something of the kind of pest mentioned has also gotten into the waters of other states. Michigan, Pennsylvania and Wisconsin have been reported as suffering from parasitic diseases, and we would like to join hands with them in making a fight against the invasion of our troutwaters, especially our lakes. Our new Commissioner, Hon. James S. Whipple, is not only a thoroughly practical business man, but he also is an ardent fisherman and is particularly interested in hatchery problems. He has invited scientific men to use our hatcheries for the purpose of study and experiment, and already we have students of the aquatic insects of the Adirondacks at work in one of the hatcheries. We hope for results and are willing to help secure them.

But enough has been said, I think, to warrant a free and helpful discussion of the problem which I believe confronts brook trout raisers. The cutting away of our forests may be at the root of all the trouble, and in our state we hope to restore the trees to our waste hillsides in time. But to do this will take at least the lifetime of this generation. In the meantime we can plant a species of trout that will thrive in the warmer waters, wherever there is a sufficient volume of flow to warrant it. The pollution we can in a great measure prevent, and it is an encouraging thing to know that in the Adirondacks one of the largest paper mills has been trying to find a scientific method of getting rid of its waste and seems to have succeeded.

I quote from the report of the legislative committee of New York appointed in 1904 to investigate this question.

"While at Ausable Forks, the Committee visited the large pulp mills of the J. & J. Rogers Company for the purpose of examining their method of preventing the refuse from their mills from polluting the waters of the Ausable River. The subject of the pollution of Adirondack streams by pulp mills refuse has long been one of public interest, and the Rogers Company claims to have solved the problem to a considerable extent. The company for some time has had in its employ Mr.

J. S. Robeson, a chemist, who has been experimenting at Ausable Forks with a new process of evaporating the waste liquor from the digestors. A small plant was erected so that a practical demonstration might be made, and the result is claimed to be very satisfactory. The water is freed from all foreign substances, including the pulp fibre, which is utilized for sizing paper, etc. It is also, by further treatment, hardened and made into cores for paper rolls. The experimental plant, according to a recent report from the company, has worked continuously since the committee's visit and has taken care of 10 per cent of the waste liquor from the sulphite mill. A larger plant designed to take care of the entire output of the mill is nearly completed and is expected to be in operation before May 1st. If such a plan were to be adopted by other sulphite mill owners the Committee believes it would go a long way toward remedying the evils of pollution against which complaint has been made."

Where the bass has been planted surreptitiously, there seems to be an end to the brook trout, as is the case in the waters of the Fulton Chain and in other lakes; yet we can do something to keep down the spawn eaters and we are doing it. But before the onward march of the parasites we are helpless.

The state of New York has planted an average of more than three million of brook trout every year in its waters for the past seven years, and the U. S. Commission has planted many millions more; but even this great effort at replacing the disappearing fish has not had the effect that one might reasonably expect. It is for this reason, and for those already given you, that I have chosen as the title of my paper, "The Passing of the Brook Trout." It is not a pleasing situation to contemplate, but it seems to me we may well say of it that, "It is a condition and not a theory that confronts us." Would it not be well to pause in our efforts to get big returns from our hatcheries for a time and to give strict and earnest attention to the problem of preservation?

While closing this paper there came to me the recently issued two volume "Guide to the Study of Fishes," by President David Starr Jordan of the Leland Stamford, Jr., University. In his chapter on the Salmonidæ he says:

"The trout are rapidly disappearing from our streams. In

the words of an excellent angler, the late Myron W. Reed of Denver, "This is the last generation of trout-fishers. The children will not be able to find any. Not that brook trout will cease to be. They will be hatched by machinery and raised in ponds and fattened on chopped liver, and grow flabby and lose their spots. The trout of the restaurant will not cease to be. He is no more like the trout of the wild river than the fat and songless reed bird is like the bobolink. Gross feeding and easy pond life enervate and deprave him. The trout that the children will know only by legend is the gold-sprinkled, living arrow of the white water; able to zigzag up the cataract; able to loiter in the rapids; whose dainty meat is the glancing butterfly."

DISCUSSION.

During the reading of his paper Mr. Whish said: The pulp mills use lime and sulphuric acid, and I do not know of any two substances, either alone or in combination, which will kill anything that is alive, quicker than those two.

We have taken tons of suckers and fish of that kind out of our lakes every year. We give them to the farmers for fertilizers.

In my judgment, the United States Commission can more profitably employ a lot of high priced scientists in the solution of this problem of parasitic disease of fishes, which means the preservation of an important and desirable supply of food, than in giving their attention to chasing butterflies and naming prize snakes of various kinds.

(Laughter and applause.)

Secretary Peabody: Mr. Whish has thrown a little slur on the modest sucker, as being a spawn eater and destroying trout. I would like to learn from some of these fish culturists what they know about the influence of suckers in ponds and streams where trout have thriven for centuries. I know of one little pond about the size of this room, at the sources of a brook in Wisconsin, and in its deep quiet pools the bottom seems solidly massed with suckers. It has a peculiar quality of water, with a peculiar sort of grass in it, suspended below the surface of the water; and if you cast a fly or minnow in the water, trout from 12 to 15 inches long will dart from under this growth just

as fast as a person can cast his hook, and that pond has been fished in for a number of years, and any one that goes there can easily get a handsome basket filled with trout; and yet those suckers have probably lived there for centuries, and the trout are there too; and it does not seem to have any influence in the supply of trout.

Mr. Meehan: The department of Fisheries of Pennsylvania, in this matter, is between the Devil and the deep sea. The people who own trout streams are constantly writing to the department, asking for permission to catch suckers from their streams, on the ground that they are destroying the spawn of the trout. Within two weeks I have had letters from two prominent associations owning trout streams, making this demand, and in both cases they stated that they had positive evidence that the suckers were spawn eaters to a very great extent; that they had actually seen them at work on the spawning beds. Personally I have not seen them devouring the spawn, but we get this testimony from all parts of the state, where the trout thrive.

On the other hand we have a very worthy class of people in Pennsylvania who are generally and commonly known as Pennsylvania Dutch. They live in a section generally where there are to-day no trout, though there were plenty of trout years ago. These men want the suckers carefully protected, and will resist any effort to destroy them. In the low lands of Pennsylvania, in counties like Chester and Lancaster, where we have open meadows and farm lands, the trout are undoubtedly decreasing in numbers; but in the mountain streams, in counties like Wayne and Pike they are decidedly on the increase. The old fishermen who have fished for 50 or 60 years living in Wayne county, report that the fishing is better there this year than it was 30 years ago. In Center county, in the mountains, famous for its trout, they say that trout fishing is better than it was 15 or 20 years ago. But in Clinton, Forest and several other counties in that section, where the lumbermen have simply destroyed the forests, the trout had practically disappeared, but with the passing of the lumberman and heavy restocking from the hatcheries, trout are decidedly on the increase in this section.

Mr. Whish mentions Pennsylvania as one of the states in which the parasite is found. Now I cannot say that that has

come to my knowledge to any great extent, as affecting trout. We have the parasite which badly affects the calico bass, rock bass, and sun fish, in many places; but thus far the trout seems to have escaped, except in isolated cases; and I do not want Mr. Whish's parasite to come over to Pennsylvania.

Our hatcheries too, have been thus far remarkably free from any disease, excepting in the old Allentown hatchery, which was abandoned, and there I think we could trace it to carelessness in not changing blood for 17 years, and the young fish lacked blood corpuscles, and were weak and died off by thousands. We had two or three very bad epidemics, at this hatchery now abandoned, both of which were investigated by the United States government, but I hardly think that we are likely to lose our trout, provided due care is exercised to prevent water pollution. Until this year, Pennsylvania was undoubtedly at the foot of all the states that did anything in the way of preventing water pollution. Whenever there was any effort made to procure legislation, to put a stop to the pollution of our streams, a howl arose from all parts of Pennsylvania, from the owners of industrial establishments, who exclaimed, "What, are you going to destroy our industries for the sake of a few fish!" But the legislature of Pennsylvania has begun to take a different view of the matter, and this last winter there was a decided change, and the prospects of continued water pollution are not very good. Heavy fines and imprisonments we find to be very potent arguments with the owners of industrial establishments. I think the day is not far distant when the tannery man and the chemical man and the creamery man will find it possible to discover some means by which their business can be conducted without pollution of streams. In fact there is a plant now being erected in one of the northern counties where the waste water from the tan bark is taken up and distilled, and the water then run back into the stream, so that there is hope that in a few years we shall be rid even of the tannery nuisance.

Mr. Marsh: I would like to ask Mr. Whish to what extent he has actually noticed the death of strictly wild trout in the Adirondack streams?

Mr. Whish: I have been watching the situation for four years, and what is reported to me is this: That fewer trout are

being caught and that the larger fish are seriously infected with a parasite, mostly the gill parasite. In other words, we are getting fewer brook trout from our Adirondack lakes than ever before, and many of those caught are infected.

But the most serious thing in this whole situation to us in New York state is the fact that we can no longer carry any brood fish at our hatcheries. We cannot carry safely a single brook trout over 15 months old in a New York fish hatchery. Now you know what that means. We used to get millions of eggs every year from Cold Spring Harbor hatchery, whereas now we get none. The same condition exists at Caledonia where we have the outpouring of an underground river, the year round, with a temperature less than 50 degrees; and yet you cannot keep a single stock brood trout in that water. The Adirondack lakes on the west side are beyond any idea, infected with this parasitic life. That is the situation confronting us; and when I said I had serious reasons for believing that other states are liable to be in the same predicament, I meant what I said. I have told the honest truth about our state in the hope that other states will lend a hand and help stop this thing. It is all very well to say you do not have parasites, or you do not have the same thing, or it does not exist to the same extent. I will not attempt to refute such statements; but I know that parasites do exist in other states beside ours, and the time is going to come when somebody else will have to stand up before the society, confess, and ask for help, just as I am doing now.

Dr. Gorham: I suppose you find them more or less everywhere?

Mr. Whish: Not to that extent. They are increasing, and nothing is known to science to stop the disease. That problem is not being studied. The scientists are engaged in furnishing a better nomenclature for fishes instead of a cure for the parasitic diseases.

Mr. Titcomb: Do your refer to Lake Clear alone as being infected, or the general chain of lakes?

Mr. Whish: I mean the entire chain.

Q. How long have these parasites existed there?

A. It is my belief that they have existed from the beginning of time.

Q. Do you think the changed conditions due to deforestation or pollution of the waters have caused the increase?

A. I don't know. I have a strong suspicion that way.

Q. It is true, is it not, that there is deforestation around those lakes?

A. Yes, most of the wood has been removed and there is pollution present, and it is growing every year, so are the parasites; and the brook trout are disappearing.

Mr. Titcomb: I think the proposition is beyond the scientist. The same problem presents itself in crowded cities, where, among the poorer classes you have dirty, filthy tenement houses, breeding all sorts of disease, and these diseases go out to a certain extent among the well-to-do classes. But the trout is quite as clean as a human being, and needs quite as clean water; and therefore when you get the filth you have in those lakes you may expect the trout to become diseased. I do not believe the scientist can overcome that difficulty. You must stop water pollution by legislation, and then disease will cease.

Mr. Whish: It occurs to me that your simile about the tenement houses is very good. I had the pleasure of working in New York some years as a newspaper man, and was there when the tenement house agitation was going on, and I know of my own knowledge that the association of tenement house reformers improved that condition. Why can not our scientific men give us a hand and help us in this situation now? I do not imagine that we can control fish diseases in natural waters, but that is not the proposition. What we have is a fish hatchery containing water, the flow of which we can regulate, and we can regulate also the number of fish and their food. Now why can you not successfully combat a disease which is killing that particular kind of fish? I think it can be done, if the disease is studied. I have tried to collect the literature of fish diseases but I do not know of a single general treatise on the diseases of fishes that is published in this country. The only one I know is by Dr. Bruno Hofer of Munich, and that deals with different fish than ours.

Mr. Titcomb: I do not wish to intimate that all these fish diseases are beyond the possibilities of the scientist, but an ounce of prevention is worth a pound of cure; and in the Adirondack Lakes the prevention means to stop the deforestation and stop pollution. In the face of the evils resulting from deforestation and the pollution of waters, science is helpless. On the other hand, in connection with the hatcheries and all over this country, in connection with practical problems of fish culture, the scientist is needed. There is enough to do to keep all of the scientists of the country, including those who are traversing the country on less important missions, on practical problems of this character for years.

Mr. Atkins has given an admirable paper on one of the problems, to-day. This question of suckers should be taken up. Who knows whether the sucker is really a detriment to the fish pond? Who is positive of it and can prove it? We may say that it is a case of the survival of the fittest. If the pond is better for trout than for suckers, the trout will survive. On the other hand, if, owing to deforestation or pollution, it is more suitable for the sucker, he survives the trout.

Mr. Whish: I do not want this thing to stop here. There are men right in this room who know about this matter. I have had letters from some of them. The reason I presented that paper was not because I know more about the subject than others, but because I knew something about it in our own state. We are in trouble there and we are here to confess it; and we want some other gentlemen, who have had trouble of the same or similar kind, to tell us about it. If we are going to have an experience meeting, let us give our experiences, and if we cannot do that, let us pray. (Applause.)

Mr. N. R. Buller: I would like to ask, what have you been accustomed to feeding your trout at your hatcheries?

A. Nothing but liver.

Mr. Buller: I think that is one of the causes of the parasitic growth.

Mr. Whish: So do I, but you cannot get our hatchery foremen to think so.

Mr. Buller: I have followed the cultivation of trout for 28 years, and I find a parasitic growth frequently attached to the trout that are feeding upon liver: while in ponds where the water was coming out of the same stream and where I had both suckers and trout in the pond, and feeding on fish food, they never developed a parasitic growth of any kind.

Now, while the sucker may be a spawn eater, I think he is also a good scavenger; but I have found that the parasitic growth very often occurs in liver feeding, especially when the liver is partly decayed.

Mr. Seymour Bower: Some 15 years ago we used to take about 2,500,000 brook trout eggs at our Paris hatchery, but they began to be attacked by parasites, ulcers, etc., and the trout continued to die off. Our stock decreased until the production ran down to about 800,000 per year. We changed foremen about six years ago, and now we are getting over one and one-half millions per year. Perhaps there may be something in that. Try that.

Mr. Fullerton: We have had some trouble, but it was of short duration. It was our own fault. Our ponds were consstructed of wood. That is where we kept our stock fish always. The ponds were allowed to stand there year after year, and when I took up the work 10 or 11 years ago, I found that a lot of the fish were diseased, especially in the gills, and were dying. I said to the man in charge: "I do not believe that these ponds are suitable." "Oh yes," he said, "they are all right." But we commenced to experiment with them, made cement sides, instead of wood, kept the natural bottom, and noticed the difference right off. We eliminated the old stock that were diseased, and put in new blood entirely in these ponds, and found that the loss decreased nearly 50 per cent in a short time. And we found the food had something to do with it. Our man would go out in the morning, take a pail of liver, throw it into the pond, it would settle to the bottom, become sour, and infect the fish. We changed the food and the fish thrived. At the present time in both of our hatcheries there is very little loss from parasites. Nine or ten years ago we lost nearly every stock fish in the pond from parasitic disease, whereas now our loss is less than two

per cent. In case of disease we separate the fish right away, and throw salt in the pond.

Food and the condition of the pond are the important factors. Get as close to nature as possible. That is my belief and experience.

Mr. Whish: I notice one of the speakers said his fish developed ulcers. Apparently the disease which cleaned out the great Cold Spring hatchery has been abroad. I have read the reports of the society and of the United States Fish Commission carefully, and do not remember seeing anything about it. Now this boil disease is a fearful, deadly thing. Dr. Marsh will tell you that he went to our Cold Spring Harbor hatchery and gave his best skill to it. He told us to do some things, which we did. In fact we did more than he told us. We cleaned out every one of those old stone ponds and wooden ponds and put in nice clean cement ponds, and brought down from the Adirondack region several thousand fingerlings, wild brook trout, and put them in there a year ago. He says that the water is all right, and you would think so yourselves, if you saw it. It is as nice looking water as you ever saw, — ever so much better looking than what you have out here at White Sulphur Springs. It is clean, cold water, so far as outward appearances goes. Everything went along nicely down there up to the first of May. Then the brook trout were 15 months old or more, and they began to die just as fast as the others died a year ago; just as others died 9 years ago; just exactly as they are dying to-day. They have what is apparently a series of boils develop on them. These boils burst just as they would on a human being if let alone, and they contain the same bloody serum found in boils in human beings. The fish died at the rate of 700 a day in the Long Island hatchery; and to-day that hatchery has nothing in it except a few fingerlings raised from eggs, brought from Massachusetts. That deprived New York of a supply of 4,000,000 to 5,000,000 of brook trout eggs yearly, and I do not know where we can make it good.

These are the plain facts about the situation in New York state, and other states will experience the plague later, if they have not already done so.

It is not a pleasant subject to dwell on, but I fear most of us must face the situation sooner or later.

Mr. North: When in Campbellsport I visited the Pleasant Valley hatchery. Everything seemed to be in good shape there, but they cannot keep a brood trout in the hatchery.

Dr. Evermann: The gill parasite was discovered a great many years ago. Long before fish culture began in this country, long before trout of any species were kept or cultivated in artificial ponds, and that species or other species are found in various portions of the United States. I have seen them on the Pacific coast salmon, upon the blue back salmon, upon the cutthroat of the Salmon river, upon rainbow trout in southern Oregon, and on other wild trout. But I am not ready to say that these gill parasites were affecting those fishes very seriously. There was nothing to indicate that they were.

But that is a somewhat different question from what would be the effect of these same parasites upon brood fish at hatcheries and in the Adirondacks. Mr. Whish, I think, makes an excellent point when he speaks of the changed conditions existing in the Adirondacks, due to deforestation, the establishment of pulp mills and other manufacturing establishments upon those streams, changing very materially the character of the water in them.

I have visited a number of lakes and streams in the Adirondacks, including the Racket River, and lakes connected with it; and although I was not fortunate enough to see those waters before they were so changed, I could readily believe that the change has been very great from the conditions that existed when the forests there were virgin, when the banks of streams were lined with vegetation down to the water's edge, when there would be dropping into the stream various sorts of insects, and insect larvæ from the overhanging trees and bushes. The waters of those streams were doubtless colder than now, and flowed much more uniformly then than now, aside from the more serious question of pollution which come from mills of various sorts. Take the Racket River as an illustration. During the spring of the year when there is a flow much above the average in that stream, the taste of the tannic acid in the water

is perceptible; an examination of the water in various places in that stream fails to show the presence of any of the minuter forms of animal and plant life, such as the small crustaceans, protozoans and algæ upon which the young trout would have to feed at that time of the year. The leachings of the logs and the presence of bark and fragments from those logs and saw-dust in the stream covering up certain portions of the bed, are alone sufficient, so far as I could detect, to kill out all the food upon which the young fish would first feed.

While it would affect fatally the young fish of that stream and similar streams, I cannot but believe that it would affect the adult fish also, and that brings us to this point then, that a parasite, like the gill parasite, which under normal conditions, in the streams of the west which are usually not so seriously polluted, would not be a serious thing; yet for the fish in those streams where the conditions are not as favorable as formerly, and the fish cannot resist the attacks of that parasite, the disease spreads with startling fatality.

All of which goes to show that in considering these questions many factors have to be taken into consideration. It is not a simple proposition, it is not a simple easy problem. There are hundreds of factors which must be considered. We cannot say the suckers are killing the trout, or the carp of Lake Erie are killing out the white fish, (which is not true, as investigation shows), but many different factors will have to be considered.

Now as to the suckers, I would not be surprised if they might do some harm to the spawning beds of the trout. But ordinarily is not this true: that in the streams in the east where the brook trout spawns, the suckers will not be in those portions of the streams where the trout spawn at the spawning time, or until the lapse of some weeks or months after the trout have spawned? Will not the suckers be found in those portions of the streams, if at all, later in the spring and early fall, long after the trout have spawned, and most likely after the eggs have all hatched?

Take the instance cited by Mr. Peabody, where suckers were found in large numbers, in a certain stream, and trout found abundantly under the banks of that same stream; he did not state the time of year, but I imagine it must have been in the

summer or early autumn, when you would expect to find suckers running far up the streams.

Mr. Titcomb: The doctor is mistaken about the suckers. You do find them on the spawning beds. Suckers seem intuitively to find spawning beds and follow them up in lakes.

Dr. Evermann: That is true of lakes, but I was speaking of streams.

Mr. Titcomb: When I spoke about the sucker and asked whether it was a disadvantage or not, I was well aware that some say the sucker is a destroyer of spawn; but it is a benefit perhaps in another way. Many birds called birds of prey are really useful in this country, and possibly the sucker has its use and furnishes a lot of little fish for food for the larger trout, and perhaps as scavengers has another use. Perhaps we should hesitate to condemn the sucker in trout ponds before the question is thoroughly investigated.

Mr. Clark: One thought I would like to offer in connection with Mr. Whish's paper on the diseases of the parent fish. Have you not in your pond fish which are being kept for the collection of eggs?

Mr. Whish: We have not any longer, Mr. Clark.

Mr. Clark: I think there are a few.

Mr. Whish: There is not a single stock brood trout in the hatcheries of the state of New York.

Mr. Clark: I mean throughout the country. We have all got to get back to nature. Your cement ponds and paraphernalia in my judgment you do not want at all. Get back to nature as nearly as possible and keep your fish in such quantities as to do the work. We have one "wild" pond at the Northville station, where the brook trout are doing well, and by the side of them, in cement ponds fry died rapidly. Now if those fry could have been put in the natural pond, I have an idea they would have lived. The fish we have there that are two years old were put in as fry, and are as handsome two year olds as I ever saw. It is as near a natural pond as can be made under the conditions.

Now where there have been new stations established, start in on the plan of following nature as near as possible, otherwise the brook trout will pass away.

Mr. Atkins: I want to second Mr. Clark's suggestion, and add emphasis to it, that what we need above all things is to follow nature more closely, and try to get away from artificial methods as far as possible.

Mr. Joslyn: It has been a sort of hobby with me for the last two or three years, that if we wanted to raise trout successfully, (and for that matter, most all kinds of fish, but particularly trout) we must follow nature. Building a pond as large as this room with no live water flowing through it so far as I have observed, is not in accord with nature. When I was a boy living in the state of Vermont, I noticed that all the streams that I went fishing in had fresh water with here and there a pond, and an eddy, or a hole under the bank in which the big trout would lie. But except when they were quiet those trout were in the swift water, hunting for their food. It is my belief that if you are going to get rid of disease, you have got to give your brook trout fresh, running water to live in and swim in; and look after their food carefully. The remarks which Dr. Evermann made in regard to feeding, I believe are absolutely correct. I have seen ponds in which it would seem a mystery that fish could live, without the bottom being cleaned. I believe what we are after can be secured by a return to cleanliness, by a return to nature's methods.

Just think of the city of Havana. Year after year it was decimated with yellow fever. Now they have cleaned up the town, they have put sewers in, their refuse is carried out of the city, and there is no more yellow fever to speak of. Why should we not have these diseases in our ponds of stagnant water? Although you may run fresh water in, it is not the live water that you see in your mountain streams. Why should we not have disease from the filth lying on the bottom of ponds? These parasitic diseases are essentially filth diseases, and their prevention lies in a return to cleanliness and nature.

Mr. Marsh: There are one or two possible remedies for these big epidemics, which might work if the fish culturist was willing

or able to put the money in to try them. The fish disease that has prevailed among United States stations, and particularly at Northville, for some years, is a bacterial disease that is caused by a vegetable microorganism, and much can be learned from the study of these bacteria. But that is not the case with the parasite at Cold Spring Harbor, for it cannot be grown artificially; but the parasite, without much doubt, arises in the water, and if you put in a filtration plant of sufficient size, and let all the water go through it, you could take it out. But that would not pay on a commercial basis, and perhaps it would not be advisable for a state or the United States to put it in.

Another remedy that Mr. Clark has in use, which is a partial remedy, that is, it permits a number of trout to be raised, but not so many as the same area would accommodate if the trout were not diseased, consists in putting the fish in a large pond, instead of small, narrow, restricted ponds such as are ordinarily used. But it does its work and prevents disease in this way: it merely increases the space that each trout can occupy, so that when the disease starts it does not transfer from one to the other as readily as when the ponds are crowded.

Mr. Clark: How about vegetation?

Dr. Marsh: The vegetation gives opportunity for natural food, and indirectly in that way is beneficial. Otherwise I do not suppose vegetation enters into the matter very much.

I have just been to the Bayfield hatchery of the Wisconsin State Commission, and been experimenting with an entirely new remedy in this connection: that is, copper sulphate, which has recently been used very largely in municipal reservoirs, both to destroy the algæ, and still more recently for killing typhoid. Its use for the latter purpose is very much more restricted than for the algæ. The typhoid germ in general is very much like the trout organism, and if this copper sulphate will kill the typhoid germ, one is led to suspect that it would kill the trout organism; and it will do so, but it is very much more fatal to fish than it is to people. You can add a good deal of copper sulphate to water for people to drink, and do no harm; but the trout are exceedingly susceptible to it, and the susceptibility varies greatly in different stations and in different waters. The disease is now

prevailing there and I have been adding copper sulphate to the water in a proportion of one to one and one-half million. On another trial I used one part to one million, and I find that that can be done without harming the trout, while it is fatal to this organism when you make experiments in tubes within a few hours, so that there is at least a fair chance of keeping the water constantly sterilized of this organism and of many others. It reduces immensely the total bacterial contents of the water, and the chances are that it will kill this trout organism. Since the use of the copper sulphate the death rate has been reduced, but that may be a coincidence, as the death rate usually falls at this time of the year. We hope another year, with the permission of the Wisconsin Commission, to commence the treatment, say a month before the disease is expected, which is about the first of June; and we will start in with the copper sulphate about the first of May, with a constant flow, and continue that all through the summer months, until the water cools off. It is the cooling off of the water at that station which checks the disease, because the microorganism cannot grow in cold water. We have a remedy here which can be applied on a larger scale, and with an even chance, it seems to me, of success. It will probably either be entirely successful or fail entirely.

Now, whether we can go further and apply that to the disease that Mr. Whish has at his station, is another matter. There is only one way to get very much evidence on it, and that is to try it in the water itself.

As the trout at Mr. Whish's station are extremely susceptible to copper sulphate, very much more so than at Bayfield, and as, if you use one part of copper sulphate to six and one-half million parts of the water, will kill the domesticated fry at Cold Spring Harbor hatchery, you must use one to seven million to be safe; that reduced greatly the amount of copper, and very likely the solution would be too weak to do any harm to the organism. Perhaps at some future time we may find another cheap poison which can be used on a large scale, but at the present time copper sulphate is the only one that offers any chance of killing the organism without killing the fish.

Mr. North: When I went to the Hammondsport hatchery it was as far from nature as possible. The brood ponds there

had wooden troughs, sides and bottom; there was no gravel there for the fishes to work off any parasites on, and there was a slime in the bottom and on the sides from the liver food. Now it would occur to me that anything like that would be very detrimental to the health of the fish.

Mr. L. N. Buller: It seems to me that we are drifting away from the point of what to feed trout. I think we are giving too much liver, for one thing, and if we get a more natural food we will overcome a great deal of this parasitic disease.

Mr. Worth: It has been my opinion for a good many years, that it is the ponds with still waters that have acted against the trout. I believe that when good trout are confined in ponds, that we are creating conditions which will cause parasites to develop on them. There are members present who were at the Woods Hole meeting two years ago, who visited the private establishments of some of the Massachusetts trout growers; and those people cultivated their trout in ditches. There were two things that impressed me strikingly; one was the immense amount of filth that was in the water from waste food, and the other was the immense number of live trout that were in there. Those present here who were there at that time know that my statement is true. They fed on chopped Menhaden shoveled in almost by the wheelbarrow load, and there were bushels of that refuse on the bottom; and in places along the banks the refuse had formed a veritable skin on the bushes where bailed out, but their fishes were healthy and the owners were making money. However they had flowing water, and I believe it is the still water ponds that create the foundation for lice and other parasites.

Mr. Clark: These fish that I spoke about in Northville are not in rapid water; although there are places where the water tumbles over quite rapidly, to which the fish can go.

Mr. Seymour Bower: I would be very glad to help out Mr. Whish if I could. The trouble with the whole matter is that what works in one case and under one set of conditions does not apply elsewhere under apparently the same conditions. For

a number of years we had a serious epidemic at the Paris hatchery; but we are not losing many trout there at the present time from disease. We do lose from 10 to 20 per cent every year as the result of handling during the spawning season. Our old foreman had grown slack, the ponds were filthy, we could not get him to take as good care of the fish and ponds as we thought they ought to have, and we made a change. Our present foreman is and always has been very cleanly, but aside from that I do not know that anything special has been done. We feed liver the same as we always did, but we do not lose fish by epidemic. We raise them to be 5 to 6 to 7 years old, and there they are to-day. We have very little loss from disease; our loss results from handling during the spawning season; but we raise quite a number each year to offset this loss. In that way we hold the stock to about the capacity of our water supply, which is more or less limited.

I was pleased to have Mr. Worth call attention to the trout hatcheries in Massachusetts, for it is a good deal of a mystery to me how they can handle the number of trout they do in the limited amount of water they have. Take the American Fish Culture Company, for example. I was told by our president that last summer they sold 46,000 pounds of trout, and besides that they are selling a number of millions of eggs every year.

We do not think much of cement ponds, still you go down to Massachusetts and find one concern using cement ponds, and another 4,000,000 or 5,000,000 eggs a year with not over 500 gallons of water a minute. As Mr. Dooley says, "There you a-a-re."

It seems to me if I were in Mr. Whish's place, I would go down to Massachusetts and look the situation over, and if possible hire some of the men who have worked so successfully for many years, and at least allow them to try their methods with your conditions. If not successful then the conditions are at fault.

Dr. Greene: Being a medical man I am familiar with diseases, and it appears to me that these trout are sick; and that that has been the condition right along; and this sickness is a filth disease, and the result of getting away from nature's good

old plans; and with that we have the attendant conditions that come from filth and uncleanliness.

Now I have had an experience as a bass fisher, which may be interesting in connection with this subject. There is a slaughter house near our city, Dayton, the drain of which empties into one of our little streams. The water is cold and apparently pure, and teeming with minnows. Now we can go out into our clean running streams and catch our minnows free from disease, put them in a tank with running water and preserve them. I had in my dooryard a tank 12 x 4 x 6, into which I could put several thousand minnows, and if healthy when put in they always did well. But when we went up to the pool where the blood from the slaughter house drains, it was very easy to catch minnows, and on one occasion we caught two bushels apparently healthy minnows. But as soon as you would get them, if you would handle them the least bit they would develop a fungus disease. I have looked in vain through all our city libraries and everything accessible to me to find any treatise on diseases of fish, and never found anything at all.

Mr. Whish: There isn't anything.

Dr. Greene: These minnows were fat and sleek, looked nice, everything looked favorable, but they had fed on the slaughter house, and they were diseased and infected, and developed this fungus disease.

Whenever you touched one of them and took off the protective slime, fungus would appear, the fish would swell up, a blood blister would appear which would burst, an open sore would develop and the minnow would die.

There is no doubt but that the disease Mr. Whish complains of, is the result of infection.

Mr. Talbott: Mr. President, permit me to make a suggestion which if not practical is at least logical.

There is in Paris a class of men who spend the greater part of their lives in the sewers and these men it is claimed are not only long lived but healthy beyond the average, yet it would seem wasted effort in training a child for such a career to insist on a degree of cleanliness that must needs be neglected in its after life. So the strenuous efforts of our fish culturists to raise the

trout clean may be a necessity since trout can not live in sewers. Until we begin getting closer to nature by the clearing out of our polluted streams it may be useless to expect to raise trout.

Under the circumstances it seems to me the highest ambition of the modern fish culturist should be the evolution of a trout that would be able to live in the tail end of a tannery.

Mr. Miller: Most of the ponds which I have seen are built very much like a window, square at the end, and occupy relatively the position of the lambrequin in this room. Your gate is in the middle of a square end, and there is a dead end across each corner. I think this hatchery of White Sulpher Springs has been built much in the shape of a coffin, and I think if we would build the ponds so the gate would occupy the whole end, and let the water come in so that the water would flow out freely, a great deal of refuse would be moved which does not now get washed out from the pond with the gate in the middle, but collects in the corners.

President: I should like to refer to the plant of the American Fish Culture Company, at Carolina, Rhode Island, and explain how they manage to raise such a large quantity of trout. Their ponds are all lined up with boards, with gravel bottoms, all narrow, their widest pond not exceeding 12 feet. The ponds where they have the best success are only 7 feet wide, with a fall of three inches in 30 feet, and in a pond of that character they will rear a thousand marketable trout, three to the pound, in a year.

In other ponds with the ends like those of the United States hatchery, with boards across the corners, the water flows very rapidly, and there is a long series of those ponds, and they are reinforced almost the whole length by driven wells. They are very successful there with their driven wells. They have several 4 inch driven pipes there that will flow six inches over the top of the pipe. It is remarkable on that account. They keep their breeding trout in these long narrow ponds, and have no trouble at all. There never has been any fungus there, no disease at all. Their trout are all fed regularly on hog's plucks, ground up, hearts and everything all together.

They had a man there who had an idea that these ponds were

not wide enough, and he experimented with one and took out the sides, extended the flow of the water so that it covered a width of probably 60 feet, and put 10,000 marketable trout in there. In less than two weeks every one of them were dead. Now that bears out the theory of the importance of a rapid flow of water.

That is all I think there is to it down there, with the exception that everything is in a wild state. The head of the spring itself, which is very like the one at White Sulphur, is a single spring. They did come very near spoiling it. They thought they would build a big pond, so they raised the dam and overflowed the spring three feet. But they did not keep it up very long; they knocked down the bulkhead and let the water run naturally. They have a flow of nearly a mile where they raise this immense quantity of trout. All their ponds are full, and they have hundreds of thousands of fry, which grow very rapidly. Mr. Titcomb, Mr. Clark, and Mr. Ravenel have seen those, and they saw no fungus, and no disease of any kind on the fish.

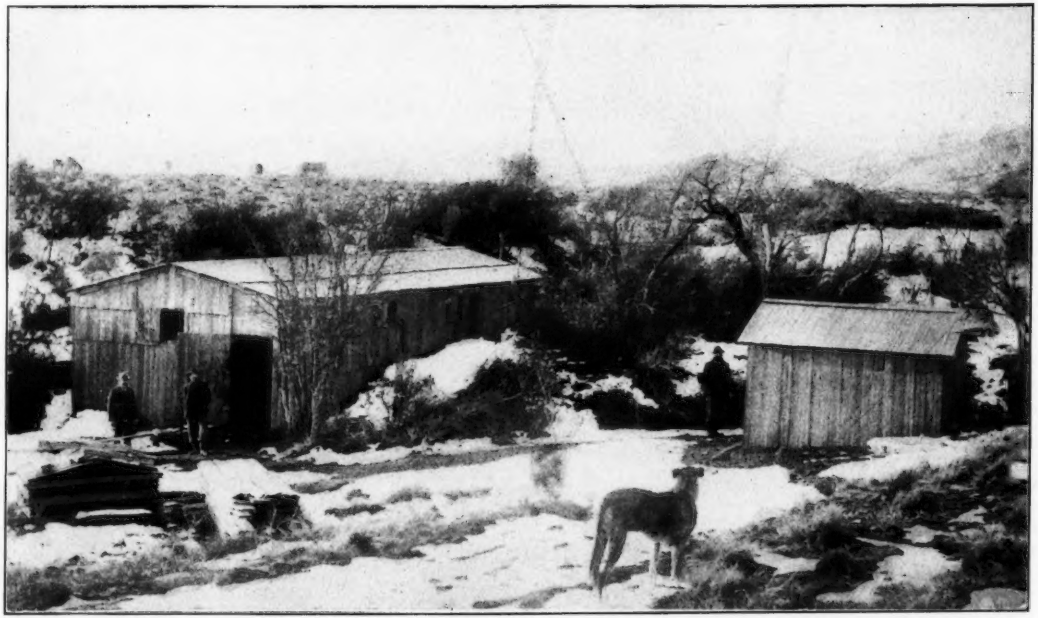
They market a great many millions of eggs every year. There is no question about it. Now I do not know why they should be more successful than others in the west; but I can say this about the state of Rhode Island, and about the state of nature. We are decidedly returning to a state of nature. Our sawmills are all gone, the country is growing up back in the rural districts, to brush; the streams are covered with brush so that it is almost impossible to get a line into them in places, but they are full of trout. I have seen 60 to 70 fishermen start out in the morning and at night every one of them return home with a basket of trout. They are getting big trout all the while. There is no trouble about it at all. Our streams there in some places run deep, and in some places shallow, and have considerable flow of water in them; and there the trout grow much larger and better than elsewhere. That I think can be traced right back to the return to nature; because the banks of our streams are covered with brush, and the woods are still there. We cut off the woods 30 or 40 years ago, but they have grown up again. We have no trouble with mills and pollution. If they want to cut down a pine forest they do not put a portable saw mill on the banks of the stream, or they would be arrested. They must put it back away from the water.

The reasons I have given account for the success had in fish culture in Rhode Island.

Mr. Whish: Let there be no mistakes about the conditions connected with the situation I have frankly described in New York state, with reference to our hatcheries. We cannot raise brood brook trout. There is no lack of water supply in the several hatcheries, with the exception of one. The other ponds have some of them wooden walls with gravel and sand bottom, and others stone walls with gravel and sand bottom and some are wholly of cement.

When I refer to the loss of the brook trout, I mean of course the old fashioned speckled trout, the fontinalis, the trout that belongs in your swift, living water, and I mean no other fish. The situation is known to at least one scientific man of the United States Commission, and we will very gladly point it out to anybody else who desires to look into it.

The condition is not a theoretical one, at all; it is a mighty serions one, and I sincerely hope it will never confront any other state, though I fear it will.



The first fish hatchery in South America. Situated at Nahuel Huapi, territory of Neuguen, Argentina. For salmon, trout, and whitefish. Built in December, 1903, by J. W. Titcomb.

REMINISCENCES OF THE FISHERIES IN SOUTH AMERICA.

BY J. W. TITCOMB.

Mr. Titcomb gave an evening's entertainment in an informal talk illustrated by lantern slides, depicting fishing scenes on his voyage from New York to Buenos Ayres and in Argentina. In addition to scenes illustrative of the fisheries, his travels and explorations throughout the country, including a trip to Paraquay, were interestingly illustrated and explained.

From September 1, 1903, until June 1, 1904, Mr. Titcomb was in the employ of the Argentine Government to explore the waters of Argentina and make recommendations with reference to the introduction of desirable species of food fish. His explorations covered a large part of the country from the province of Cordoba on the north to the northern border of Patagonia in the territory of Neuquen, in the southern part of the country. He ascended the La Plata and Paraguay Rivers to Asuncion, Paraguay.

While in the country he built what is probably the first fish hatchery in South America on a tributary of the Limay river, near Lake Nahuel Huapi. It is constructed out of hand-made lumber. Before his departure from the country eggs of four species of Salmonidae had been transported from the United States and placed in the hatchery with a loss of less than ten per cent. The loss in hatching and previous to distribution was very slight. The success in transportation merits special mention because it is probable that these eggs were carried a longer distance than has heretofore been recorded in the history of fish culture. Another feature to be considered is the fact that the eggs were taken from a climate where the waters were extremely cold, across the equator, and then during warm weather, one hundred leagues across the hot sands of the territory of Neuquen to be hatched at just the opposite season of the year from that in which they would have been hatched under natural conditions.

The work inaugurated by Mr. Titcomb is being successfully continued under the direction of E. A. Tulian, a member of the American Fisheries Society, formerly superintendent of the fisheries station at Leadville, Colorado.

DISPLAY OF APPARATUS.

It was expected that all the superintendents of the U. S. Bureau of Fisheries would attend the meeting, and all had been invited to bring fish cultural devices of novel design, that is, some of their own devices which may be new to others. As a result of this invitation the following apparatuses were on exhibition at the White Sulphur Springs Station, and one morning session was devoted to a discussion of the merits of the various kinds of apparatus and methods employed in fish cultural work in connection therewith.

Mr. Frank N. Clark gave an exposition of the Clark and Clark-Williamson hatching troughs. This was followed by Mr. Atkins, who gave an exposition of a hatching box used at the Craig Brook station under the Atkins method of eyeing eggs in stacks of trays enclosed in a stack frame. The merits and demerits of other forms of apparatus and equipment were discussed fully, but as the discussions were always illustrated by the presence of the apparatus or equipment, or models of it, the minutes of the discussions are not included in this report.

Mr. Clark exhibited the Clark hatching box, nine trays to the compartment, the Clark-Williamson hatching troughs, 15 trays to the compartment.

Two quart dipper for measuring eggs.

Whitefish scaff net.

Another scaff net for trout.

Same only smaller.

Hatching jar tube.

One quart measure with screened bottom for measuring trout eggs.

Feather with long handle.

Jar screen.

Tray for holding dead eggs.

Larger tray.

Bass fry net for taking fry out of screens.

Whitefish fry net for taking whitefish out of tanks.

Three pronged hook for removing lumps from jars.

Jar filling tube.

Long mesh screen for sorting fish from eggs.

Long drip pan for washing up fish and eggs.

Exhibited by Mr. Atkins:

Ten tray stack frame with complement of trays. This size preferred when there is room enough in the hatchery. To pick the eggs they are removed to a table, the whole stack being removed.

Troughs used for both eggs and fry. The water level mounting by dam: for fry by a hollow outlet plug and screen being put in place of the dam.

Stack hooks for lifting the open stacks out of the trough.

Deep stack frame for twenty trays of eggs, holding 40,000 salmon eggs. This is a closed frame and may be used with eggs or in an open stream. Requires trough 16 or 17 inches deep: is taken out for picking.

Egg plyers used at Craig Brook.

Dinsmore's tray lifter, used for lifting trays on which the fish are hatching (pair).

Pair Storey's tray lifter, founded on Dinsmore's.

Dinsmore fry picker, to pick up dead fry and other debris about hatching time.

Storey's fry picker, founded on Dinsmore's.

Atkin's aerator, for use in a can of fish in transportation by submerging, following drawing up and allowing water to run back.

Exhibited by Mr. Downing:

Downing fry net for removing fry from tank.

Tube for Downing jar.

Faucet to be used in connection with operating the Downing jar.

Auxiliary net for whitefish.

Hatching jar.

Exhibited by Mr. Livingston Stone of Cape Vincent, New York:

Model of new galvanized iron hatching trough of the Whitefish hatchery at Cape Vincent station.

Device for allowing anyone to hatch a few trout or salmon

eggs in the home of any one where there is a pipe furnishing running water. It will be observed that the outlet is directly under the inlet. From Cape Vincent station.

Model of a portable hatching trough, the main point about which is, that a small screw driver is the only tool required for taking the trough to pieces and putting it together again. When taken apart it can be easily carried in a pair of ordinary shawl straps, put in spawning ground in the woods or anywhere else, and set up without trouble or expense. The canvas is supposed to be waterproof, of course, although it is not so prepared in the model.

Exhibited by Mr. Booth:
Long distance asbestos packing case.

Exhibited by Mr. Lydell:
Bass net and screen.

By Mr. Robinson:
Bass nest.

Mr. E. E. Rice, Green Lake station, Maine:
Samples of wire:
(1) Wire used for fry in rearing troughs.
(2) Wire used on trays in hatching quinnet salmon.
(3) Wire used for brook trout and landlocked salmon.
(4) Wire used for false wire bottoms.
(5) Wire used for fingerlings in troughs and rearing ponds.
(6) Wire used for foot screen attached to wire bottom.
Also (7) Lifters for handling trays in developing hatching troughs.
Developing hatching troughs.

By Mr. Stranahan:
Stranahan dam board.

By Mr. Dean:
Pair fry pickers.
Perforated can top for holding fish preparatory to shipment.
Model of tube with screen in side for general use around station, for holding fish.
Bucket for same use, or messenger shipment. Model especially good for messenger shipment.

By Mr. John L. Leary, San Marcos:

Samples of fish food, including spawn of water snail, shrimp, chopped fish, maggots, crawfish, top water viviparous minnow, water fleas, fish eggs and silverside.

Pictures of apparatus giving idea of how to get water plants out of ponds.

By Mr. G. H. Lambson, of Baird, California:

Directions for making cheap paints, with specimens.

By Mr. Seagle:

The Seagle fry trough with separators.

By Mr. O'Malley:

Box for mixing salt solution for testing eggs.

Box in which eggs to be tested are placed.

Wire egg scoop.

Miscellaneous:

Expansible aerating funnel, from Swanton, Vermont.

White fish and white perch egg strainers.

NOTES ON THE FEEDING OF PARENT TROUT, WITH REFERENCE TO VIRILITY OF EGGS PRODUCED.

BY GEORGE R. ALLEN.

A change in my duties prevented the completion of the experiments set forth in this paper, and it is presented in the hope that some one in a position to do so will continue work along the lines indicated.

The brood ponds utilized for the experiments were each 25 feet long, 12 feet wide, and contained water to a depth of 4½ feet. During the season of 1901 the brook trout in them, at that time six years of age, yielded an average of 1052 eggs per fish, and an equal number of males were stripped to impregnate the spawn. Of the eggs obtained 9 per cent were lost during impregnation.

At the close of the spawning season the fish were divided into two lots. The first lot were given a diet consisting of two parts sheep lights, one part sheep liver, and one part sheep hearts. The second lot were fed solely on dead trout eggs up to April 18, at which time their appetites began to increase. As the supply of dead trout eggs exceeded the number required in feeding, the surplus eggs were frozen and preserved in a refrigerator, the last of them being fed to the fish on June 4. Beginning on April 18 the second lot of trout were given a mixture composed of four parts bran, two parts fish eggs, one part each of meal and sheep hearts.

During the progress of the experiments no salt was placed in the food of the fish or thrown into the ponds. At intervals of once a week a bushel of swamp or wood earth were placed in the spout leading to the second lot of fish and allowed to wash into the pond, the water supply at such times being increased one-third, and on each following day all sediment and decayed vegetation was removed from the pond, thereby giving the fish a second bath. It was noted that on these and the succeeding days they were more active and that their appetites were much keener.

The loss during the year among the first lot amounted to 14 females and 16 males, while that among the second lot was 8 females and 7 males, or exactly half the loss in the first pond. The fish in both inclosures began spawning October 3. Of the first lot 75 females yielded an average of 1021 eggs or 31 less than the average of the previous year; 89 males were used for fertilizing them. Two per cent of the eggs were poor when taken and a further loss of 7 per cent occurred before the date of hatching. The average weight of these fish when placed in the pond was 7-8 of a pound, and at the spawning period it showed no increase. Their color also was somewhat dulled.

The yield of eggs from the second lot of fish showed an average gain of 18 eggs per fish. To impregnate this lot 86 males were stripped. One per cent of the eggs were poor when taken and a further loss of 4 per cent ensued during the hatching period. The fish had gained an average of an eighth of a pound during the year and their colors were brighter than when placed in the pond.

The fish of the second lot produced an average of 49 more eggs per fish than the first lot, and the loss up to the time of hatching was four per cent less. The loss of fish by disease in the first lot also exceeded that of the second lot by 15, but there appeared to be little, if any, difference in the fry hatched from the two lots of eggs.

Nearly all of the fish lost suffered from gill affection. Both ponds during the course of the experiments were kept scrupulously clean, and so far as it was possible the conditions in both were made identical.

POTOMAC BASS.

BY HENRY TALBOTT OF WASHINGTON, D. C.

The first object of this Society is " to promote the cause of Fish Culture."

Fish Culture has two groups of beneficiaries—the consumer, together with those who labor for his benefit—that is the commercial side—and the Angler.

It is from the standpoint of the latter that my little contribution is made, and it is fair to say that the term "angler" is used not for the flyrod's 400, but to include every one who catches fish for sport—from the barefooted boy's elder pole to the bamboo whip. It is not inappropriate that you should hear what some of us think of you and besides you need us to supplement your work. All the fish you could put in would do no good if we did not take them out.

It is peculiarly fitting that the Potomac should receive your attention, for to mention that river is to throw bouquets at Fish Culturists. The Black Bass is an alien to that stream, yet he has flourished in its waters as have our forebears on its banks, and as there is no country in the world like our own nation of immigrants, so is there no Black Bass river to compare with the Potomac. Rocky and rushing for three hundred miles of its length it is to the Small Mouth Black Bass as ideal a home as is the Nepigon for the trout or the Restigouche for the salmon. For three score miles below the Little Falls its coves and hundred creeks with the sluggish waters of the tide-water marshes and their wealth of food makes to brackish water, Large Mouth Bass, as suitable homes as do the lagoons and lakes of Florida. and he would grow to as great size even to match that mythical 23-pounder of southern fame—if the fishermen and the anglers would but give him a chance. The latitude is not against him, for I have seen two bass from Peters' Lake, Missouri, a latitude not lower than this, of about 12 pounds, and they have been found here of above nine, but overnetted fish grow small.

It is said the average of shad in the the Potomac were long ago of 14 pounds weight and they do not now reach half that

figure—the wonder is, any are able to filter through the pounds and seines and drifts and dips that dispute their passage from the Capes to the Great Falls. Indeed, they would long since have disappeared as a commercial product of the Potomac but for the wonderful success of the fish culture, which this society does so well to encourage, and in which our Government beats the world. The Chinese, with their eggshells of fertilized spawn knew some tricks of their own before we moved over here, but in these days of railways when a carload of a million of fry may be sent to any corner of our country, eggshells of spawn sounds about as effective as shooting elephants with firecrackers, or using a lightning bug for a searchlight.

You are all familiar with the fact that the Small Mouth Black Bass were planted before the war, at Cumberland, on the Upper River, having been brought over the mountains from Wheeling Creek, in the tender of a locomotive; that the river was then full of suitable feed, and that the conditions which made the Potomac a dead line between the contestants, made angling for some years along its banks an unhealthy occupation, if there had been time to indulge in that pastime. As a consequence the fish spread as never did fish before or since—for never was so effective a close law anywhere else; one that threatened to pull a man's cork under if he showed himself on either side, and when matters settled down and the riparian dwellers had leisure to try the river—to everybody's astonishment—it was found to be teeming with bass. The official reports tell of how all the cities of the East were supplied from here—the Susquehanna and other streams were stocked, and hundreds of fishermen found summer employment and revenue from their capture. Afterwards the efforts of distribution of black bass in my own State of Illinois, proved so successful that the government went into partnership with us, and have since supplied the world with stock mainly from this source, and since this fish resists artificial propagation the arrangement is a fortunate one. These are principally the Large Mouth Bass, and they have been placed in the tidewater Potomac, and the tributaries of that estuary, where they have wonderfully thriven, until, permit me to repeat, there is no Bass stream like it anywhere when the sun is clear, but there is a strange variability of the angler's luck in this river.

Some Small Mouth Bass have been planted in the lower river, and, of course, from time to time, have come down from the Upper River in floods or wanderlust, but they are unsuited to these quieter waters and muddy bottoms, and are not plenty like their cousins, just as the Large Mouth has in later years occasionally been placed in the upper reaches, but do not find it congenial since by then the Carp had found a lodgement in the pools where the Large Mouth Bass might have made a home—and he left in disgust.

The Carp cannot drive the Bass out or disturb his nest (he does not eat the bass spawn, as it is stuck to a gravel so tight he'd have to bolt a ton of pebbles for a pound of jelly); the Carp with his velvet sucker mouth is about as bloodthirsty and ferocious as the rabbit, and probably fights the same way by butting, while the bass will tackle anything that approaches his gravel-pan. This assertion is made without any pretense of superior information—but a conviction born of years of observation—that all the stories of Carp eating bass spawn are pipe dreams—sometimes dreams come true—and somebody may sometime prove that Carp are fond of bass nest soup, and then I shall be in the position of the listener whose friend telling a miraculous yarn wound up by saying "I wouldn't have believed it myself if I hadn't seen it;" and who retorted: "Then, you of course, will pardon me." But while the Carp cannot disturb the Bass spawn-beds, his digging in the mud and clouding the water does disgust the Bass as it does the bait on which he feeds and any other self-respecting denizen of the pools, and the Carp soon has the mud to himself. While what I have to say is assumed to be in the interest of everyone who takes fish with an angle, without regard to lure, my own preference is for the artificial fly—and though making no claims to any superiority for that way of taking fish—and admitting as much skill and pleasure—and science in the other methods—and though under many conditions of cloudy water or deep, the fly is useless—none other appeals to me; and with that introduction I desire to proclaim—what many people will consider a heresy—that in his season the Large Mouth Bass is better sport than the Small Mouth Bass from the warm waters of the Potomac or the chilly waters of

Canada—and in competition with the incomparable trout of the Nepigon.

It is easy to understand why one should fall into the error of disparaging the Large Mouth Bass. Half the good of a health resort comes of the attention to hygienic rules, as easily practiced, but so often neglected at home. Half the pleasure of the summer's fishing trip is the change and effort.

We value most what costs the most and are prone to disparage the cheap no matter how good.

The Large Mouth Bass can be raised in anybody's back yard, and is the best fly taker of any fish that swims—yet nine out of ten anglers at the Capital will assure you that there is no pleasure in taking it, that one Small Mouth will give you more fun than a dozen chub—as they will persist in calling the Big Mouth in Virginia. Strange to say these bass are learning new habits in their new home, and instead of a fixed habitation as we have them in the Western lakes and rivers, the Large Mouth Bass of the Lower Potomac follow the lead of the anadromous fish, and run up the creeks in the spring, maybe for shallow gravelbeds to spawn, and wherever shad or herring are caught or dipped there too they take the bass. As soon as a chill strikes the water in the Fall they make another run from the river, and every small creek becomes literally alive with them—if they are not headed off with nets—just for what purpose this up-stream autumn pilgrimage is made is not apparent. It was thought, to seek the shallows to hibernate, until catching bass the year round rather exploded that theory—or that nearer the springs they found warmer water; at any rate, up they go—and when word comes to town in late September that the fish are "running up" the anglers who never go "down" at any other time, start out. The water is chilled, the fish are sluggish, and deserve anything harsh that may be said of them—so the language is milder than that applied to the men who ought to know better.

The Little Mouth is no better when his element is chilled, and big catches of these are made late in the season in the Upper River when the bait moves off as if it was asleep and the fish comes up as if it was dead.

The fish is a cold blooded animal, and he only gets to be "hot stuff" when his element is warmest.

The Horse Mackeral is found around the world, but it is only at Sunny Catalina that he earns the title of the Leaping Tuna. To see the giant herring cleave the air you must go to the hot waters of the lower Gulf Stream, though these Tarpon have been caught in the Potomac. Even the Trout and Salmon are only lively in the summer months, and the Grayling further north succumbs to a hunk of pork for a lure. Now, if you will do the Large Mouth Black Bass justice to invite his attention when he is at his best, when the bugs are on the water, and the flies are in the air, he'll surprise you with such ground and lofty tumbling as would put a trout to shame. He is not sluggish—he doesn't quit—he'll leave the water higher and oftener; stand on his tail and shake off every drop of water in his effort to void the hook and plays pranks to the boat where the trout would only be trying to bore through to the seat of war.

Then, too, the unwise say he is not good to eat, and there is no better meat with bones, but ninety-nine men out of one hundred still string fish, and a water soaked fish that has died and bleached in the sun on a string in shallow water—such as one may see in any group of anglers—or such fish as the netters send to the markets in hot weather, are scarcely fit for food, and, of course, are not palatable.

If, when you lift the Bass out of the water, you will bleed and draw him, you will find a greater difference over the fish you probably know than between a peach and a horse-chestnut.

In my opinion, no man living can tell whether he has a Small Mouth Bass or a Large Mouth on his line or on his plate from the fight for flavor, if neither has a card, and, confidentially. I lean a "little" toward the one whose smile reaches to his ears. He is so satisfying, and gives such confidence when he comes up after your fly, whether splitting his Nelumbium umbrella in an Illinois Lake, or turning sommersaults at midnight in the St. Francis, or racing a pike for your fly down the Potomac—he's all there and when he gets it—which he's sure to do—he'll come again and again for it, rapture!

But the object of all this is to invite your attention to the fact that for three years there has been no fishing in the Potomac, and to beg you to tell us why? To save you guessing, it may be as well to run over the reasons which have occurred to us:

First, as a matter of course, has been the pollution of the Potomac. Tanneries and pulp mills coolly appropriate the water that comes, and foul the water that goes with as little regard for the rights of others, or the laws of the land, as insurance managers or merger promoters. They pour poisons or shavings into the water, their neighbors must later drink, in a perfectly inhuman way, and with not only a recklessness of consequences, but with a brazen assurance that grows indignant at even mild remonstrance as an impertinence until as an acquaintance commenting on the forced submission to these corporate wrongs, put it: "If nihilism could offer any relief, these fellows are in a fair way of making converts." You cannot appreciate unless you have seen the effect of a couple of pulp mills filling up every pool for miles below with rotting shavings, and then look at a club record with scores up to three years ago that were good enough for anybody, and since then not an entry. The Blue Ridge Club below Harper's Ferry, with some of the most enthusiastic and expert anglers of the Capital, have not made a catch in three years and pollution would seem to be answer enough to the question and probably is for that locality. A paid guide at Harper's Ferry will today point you to pools and tell you the shavings there are thirty feet deep. But too little is known of the effects of pollution even by these scientific sharks whom we are proud to number among our friends—a few experiments have been tried of the effect of putting some fish into a tank with shavings to see how long they would last, but it will require years of investigation and more appropriations than the corporations are like to allow, to determine the effect of these various contaminations upon fish life. It isn't alone whether a bass may live some weeks over a bed of fresh shavings, if he must, but what is the condition of a bed decomposing for ten years? Will the smaller fish the bass eats live? Can he spawn in a poplar mattress? Will the vegetable life exist that is necessary for the tiny brood? What changes in the Plankton result, and what chance has the small fry in a garden of excelsior? By the time these questions are all answered they will have used paper enough to exhaust the forests on that stream, and the mills will have moved. The fact is, Draco's idea ought to be applied to these fellows. He had but one punishment. The smallest

infraction in the law, he said, deserved it, and the greatest could receive no heavier penalty. So of pollution. The limit for any infraction, the smallest deserves it as well as the greatest. But pollution is not enough to explain the strange recurrence of good and bad fishing seasons. It is not seven years of plenty and seven years of famine, but the alternating periods for the last fifteen or twenty years are about five years each. It is overfishing in the good years that exhausts the stock, and must we wait for a re-stocking? Is it exhaustion of food supply that leads the bass to turn cannibal, which he will do under stress, and is it the real race suicide that depletes his ranks till the food supplies again come up? None of these are satisfying theories. There is still another so remote as to excite derision among two classes: Those who know it all, and those who don't know anything. To plant potatoes in the dark of the moon is, with most, a matter of jest, yet there is an Angler's Calendar based on phases of the moon, to which some fishermen are as devoted as the sailor to his needle. But this doesn't help us in the present inquiry, for that calendar only points the best time of the month to fish. What is wanted now, is an answer to the questions, which are the best years to fish, and why?

The periodic recurrence of sunspots has aroused the attention of the scientific world, and a storm of conjecture as to their nature, origin and effects on earthly phenomena. The sum total to date of published information on the subject seems to be as vague on these points as to the whence, why and whither of the Aurora Borealis.

But while we are scientifically ignorant of the cause of these spots, their purpose and influence, it requires no F. R. S. to follow their periodicity, and to note the coincidence of certain phenomena. That the maxima are between ten and eleven years may be taken as established.

The territory of the Central United States along the Great Valley of the Mississippi, say in the neighborhood of St. Louis, is subject to overflow that threatens for a series of years, but culminates one year in ten, for instance, in 1893 and 1903, in destructive floods. These are the years of the greatest number of sunspots and with these immediately succeeding are marked by severe winters, and wet cool summers for that parallel, and these

we have regularly, the last three being easily recalled for the Washingtonian. In these years we catch no fish. Now, again, why? It is not a fortuitous coincidence for the fishing of the entire river is affected, and for the last two seasons comparatively no shad were taken in the Potomac so that the andromous fish were also discouragingly scarce. With a remote interest in the largest seine on the river it has been impressed upon me that these seasons have been rank failures, that net has gone nearly bankrupt for lack of shad, and the Commissioner's records will bear out this statement. Again, why?

The long icy season, the cold spring and the chilly water may check the run of shad. It takes sunny days and warm to bring them out on the shallows where the nets are operated. Failing these, the shad, such as run, hug the narrow ten fathom channel and sneak past the threatening webs. But even at that they ought to show in greater form in the upper waters. They were probably more numerous than usual this year at the foot of the Great Falls, the end of their run, but missing millions are unaccounted for.

Now, the Bass fishing in the Potomac from one end to the other has been practically nil for the same period. The flood years are seasons of rain, feed may be washed away, spawn beds may be destroyed, the numerous rains keeping the river muddy, and banks full through the fishing season. The burning question still is: Why is the Bass fishing in the Potomac poor for for three or four seasons in succession corresponding to the sun-spot periods? And may we expect big strings in 1908, the next year of no spots and of drought? A friend in New York who formerly spent his week-ends on the Potomac and is familiar with all its famous stretches recently wrote me of some of his marvelous catches and noted his greatest as made in the season of eighteen years ago—that would be 1887—and would bring 1907 as the coming good year. It is but a corroboration—1907, '8 and '9 ought to be drier and hotter than the last three years, the water being clearer, the pools lower and more fish caught. In each decade are the 3's the poorest fishing and the 8's the best? The question is asked that you may smile if you like, think if you will, answer if you can.

DISCUSSION.

President: There are some pretty hard nuts to crack here and I hope you will proceed to crack them if you can.

Mr. Clark: I think the reader has cracked one nut for me. If the sun spots are "it", that is the reason we did not catch so many white fish as during the year previous. We shall have to lay it to the "sun spots."

FISH PROTECTION.

BY OREGON MILTON DENNIS.

(Secretary and Counsel Maryland State Game and Fish Protective Association. Assistant State Game Warden.)

Great difficulty is at once apparent, especially to you, gentlement, of presuming to suggest a solution of this great question of fish protection. This condition is brought about, first, by the belief that he, the fisherman, has an inherent and inalienable right of fishery, which has come to him through a long line of ancestry in the same way in which an estate tail operated at common law, and a right which neither his fellow citizens, land owners or the state can take from him, or in any sense abrogate. That the right of the state to legislate for the protection of fish was settled as far back as the Magna Charta is of small concern to him.

The first problem then is the education of the takers of fish as to the right of the state to legislate for their protection and to make him understand and believe that the only interest that the state has in passing legislation for their protection is for his protection, for the state derives no benefit *per se* from the increase of fish in the waters within its boundaries, but the proceeds thereof go directly to the fisherman.

Then again, fish protection does not appeal to the fisherman as does game and bird protection to the hunter and sportsman. The absence of sentiment and the application of the senses of sight and sound which appeal to the aesthetic nature of men as well as of women whose early morning slumbers are brought to an end by the beautiful songs and warblings of the songbirds; the beauty of their plumage to the sight, the steady arm and true aim of the sportsman who kills his pheasant or his quail or his deer or his rabbit—none of these things appeal to the fisherman, who throws his net trusting to Providence or good luck to fill it with the finny tribe—not that any of his senses shall be gratified or his troubled brain soothed by song, but how much will the catch be worth. This is the only senti-

ment that controls the market fisherman. He cares not for his fellowman nor his state, but how much is there in it for him, that is all. Hence the difficulty in enforcing laws, even after proper ones are passed by the state for fish protection. That this sentiment alone controls him and that this is the reason that he will not aid in the protection of fish goes without denial. And even if you try to prove to him that by seeking and taking undersized fish or by the destruction of spawn he will exterminate them, and if he will let them grow, he will secure a larger increase in the revenue from the industry, it is not believed by him. I have used this argument time and time again. A few weeks ago at a trial of some cases at Rock Hall, Maryland, and at which I secured the conviction of a number of fishermen for violating the fish laws, I made this argument: In the Baltimore markets this past spring perch of the size of about eight or nine inches could not be had for less than fifty cents per bunch of six or seven, while fish of a size prohibited by law in our state, to-wit, seven inches, sold and could be had in plenty for some ten to fifteen cents per bunch of eight or ten. I appealed to them on the ground of a cold-blooded financial proposition, showing the difference between securing twelve cents for a commodity which undisturbed would bring fifty cents within a single year, but as usual a deaf ear was turned to all my arguments, and they are at this time daily violating the law.

I do not refer to the angler's destruction of fish in this paper because he plays but a small part in fish destruction, for in my state I really believe that a good haul of one purse net destroys more fish than all the fish taken by all the anglers in a season.

Therefore, while the education of the finer sensibilities of the children, the women and the sportsmen will bring about the natural protection to a large extent of the song and game birds, the market fisherman refuses to be educated on these lines, hence the first problem. The fisherman must be educated on other lines—the mercenary ones. Appeals must be made to his pocket rather than to his heart or brain. He must be taught to believe—which is a fact—that he is killing the goose that is laying for him the golden egg; that he is putting at defiance the better wisdom of the state which passes laws for the protec-

tion of a commercial commodity for his sole benefit; he must be educated up to the fact that fish are the sustenance of life as well as palatable to the taste; that notwithstanding the artificial propagation of fish the state's propagation cannot keep up with his unnatural destruction of them.

From time immemorial the market fisherman has racked his brain to create some device by which he can take the largest number of fish with the least trouble, expense and work to him. From the primeval means of the Indian who used his spear, we have now come to the system of nets, with the use of which, in a short time in many of the states, many species of food fish will be entirely exterminated. The market demands for fish can never at this day be filled with the natural supply, hence I take it that this was the reason that the United States government and the state government inaugurated the artificial propagation of fish and which has resulted in the formation of the American Fisheries Society, when at least once a year its members may get together to discuss means for the better and more effective propagation of fish.

I must plead ignorance as to any solution of this problem of fish protection in any of the states other than my own and the states that adjoin it. Beyond any question of contradiction I claim that Maryland has in the Chesapeake Bay the richest body of water in the world; not only in its finny tribe, but its terrapin, its oysters and its crabs, which are world-famed for their value as well as their deliciousness. At the same time there is less protection in Maryland for these than in any state in the union.

To particularize; almost every net that is used for the taking of fish in Maryland is prohibited somewhere in the state. One county will prohibit the use of a certain net and the adjoining county permit it. Purse netting, the greatest known destructor of small fish, is prohibited in Maryland, but only above a certain line in the Chesapeake Bay.

In 1902, after much labor, the Maryland State Game Association, through its secretary, prepared and passed the bill which is known as "The Fresh Water Bill for the Protection of Bass, Pickerel, Pike, Perch, also known as wall-eyed Pike, California Salmon, Yellow Perch, Rock or Striped Bass, making

it unlawful to take any of these fish of a certain size, to-wit, white perch less than seven inches in length, yellow perch less than eight inches, pike less than fourteen inches, rock or striped bass or tailors less than ten inches, and black bass less than eight inches, and provided further that the season shall be closed at certain times of the year in which these various fish may spawn." One of the fairest bills for fish protection that I know of, admitted to be such by the members of the Legislature who passed it, but notwithstanding the fact that they admitted it was one of the best bills ever presented, the representatives of nine out of the twenty-three counties had it exempted from operating in their counties.

This bill also made it unlawful to have in possession or offer for sale any of the above enumerated sized fish in the City of Baltimore. Now what is the result? I began first to have arrested the wholesale dealers who offered for sale undersized fish. From this began howl No. 1, resulting in the bill going to the Court of Appeals on the ground of unconstitutionality, but which the Court of Appeals sustained.

I then began a crusade against the retail dealers, which brought about howl No. 2. Their chief complaint was that if a fisherman was not permitted to catch fish undersize, then they would have no undersized fish to offer for sale. I then attempted to pursue (and in many cases succeeded) the catchers of undersized fish, but on going into certain counties my hands were tied because that particular county was exempted from the provisions of this bill and I was up against this condition, that while it was lawful for them to catch undersized fish, according to this law, in the waters of their county, it was unlawful for them to take such fish to Baltimore to offer them for sale.

I merely mention this to show the chaotic conditions which are prevalent not only in Maryland, but in other states of the Union, where the local laws of a county are superior to the state laws. Our state has been working for a long while to get a uniform and consistent fish law for the protection of all kinds of food fishes, but without result, and this may be apparent to you when I tell you that there are certainly thirty thousand vot-

ers in Maryland engaged in the fish and oyster industries, and most of these are on the Eastern shore of Maryland. You can draw your own conclusions.

Since my induction in office, April 1st, at a rough estimate I have prosecuted not less than 100 cases of violation of the laws and imposed fines ranging from five dollars (which is the minimum) for each fish, up to one hundred dollars. Nets have been destroyed and confiscated, and notwithstanding all of this, violations are going on and fishermen persist in violating the law, trusting to escape its penalties. On the Susquehanna Flats alone there are to-day estimated to be one thousand fike nets; in the Chesapeake Bay there are vessels daily using purse nets, and in the Chesapeake Bay and its tributaries there are a sufficient number of pound nets, if put in a straight line, that would reach, I was going to say about two hundred miles, certainly a length that would surprise you.

On last Tuesday, the 18th, for the first time in the history of fish protection in Maryland, I succeeded in arresting and taking into custody two schooners with their crews, consisting of thirteen men; four 24-foot yawl boats and two purse nets, one of one hundred and thirty fathoms and the other of one hundred and sixty-five fathoms, but in doing this, which is the greatest stride yet made by the state in breaking up purse netters, I only got two vessels out of a fleet of five.

But I am taking up too much time in this matter. Fish protection in Maryland, as I presume in other states, needs a number of things to solve the problem. I suggest:

First. After the passage of protective laws to provide the authorities who have the protection in charge proper machinery with which to enforce these laws. I mean by this high speed vessels to reach those boats that attempt to escape after being detected.

Second. Pound and purse nets should be prohibited in all the waters of the state without any exception.

Third. Such nets as are permitted to be used should be of a sufficient size mesh to permit the small fish to go through without gilling.

Fourth. Stringent laws should be passed to prevent the taking of any kind of fish at any place during the spawning season.

Fifth. Laws should be made to carry out the above suggestions and to put a heavy penalty for having in possession any net of a size not large enough to permit the free passage of undersized fish.

Sixth. The passage of a uniform law by the states, fixing the minimum size of fish to be had in possession or offered for sale, thus preventing an adjacent state from receiving in its market fish of this prohibited size, which otherwise offers an inducement to the fisherman to evade laws of his own state and prevents the adjacent state from aiding him in its violation by taking from him undersized fish for sale.

Seventh. Putting a heavy penalty on railroad and transportation companies for carrying out of the state fish which are prohibited to be sold within the state.

I believe that the solution of this problem of fish protection lies in these two important features: First, the education of the fisherman along the lines suggested above and, second, the prohibition of certain kinds of nets and the regulation of other nets as to the size of the mesh.

I thank this Society for permitting me to express my views concerning fish protection. I only regret that my experience has not been of such a character as to permit me to make valuable suggestions for the protection of fish that you are striving so hard to increase for the benefit of the people of our state and country.

ON THE PROTECTION OF FISH IN INLAND WATERS.

BY DR. JAMES A. HENSHALL, OF BOZEMAN, MONT.

Next in importance to the proper protection of fish and the replenishing of waters, is the proper protection of the waters themselves and the fish food in them. Indeed, there are those who deem the latter measure of more real and permanent benefit than artificial stocking. They argue that if the waters are kept free of pollution, and practicable fishways established on streams, the natural increase of fishes would render stocking by artificial methods unnecessary. This view seems plausible enough were the primitive conditions of the waters preserved and maintained. But such is not the case, and never will be.

The natural conditions of all waters in the settled portions of our country have been changed. This change has been brought about by various activities that are the result of the so-called advance of civilization. Among them are the various industries of lumbering, mining, manufacturing and agriculture, and the sewage of towns and cities.

In lumbering it begins with logging.

The breeding grounds of the trouts and graylings are in the tiny streams forming the headwaters of creeks and rivers. In their primitive state they were in the midst of coniferous forests, in whose solitude and shade the banks and borders of these rills and rivulets were clothed with a dense tangle of verdure, consisting of mosses, ferns and semi-aquatic vegetation. The spongy soil was saturated with moisture that not only maintained and replenished the small streams, but favored the reproduction of the larvæ of myriads of insects, and the minute crustaceans and mollusks, that formed the first food of the baby fish.

Then these secluded precincts were invaded by the lumberjack with his axe. The forest soon disappeared, the gloom and cool shadows of the arboreal recesses were dispelled by the admission of the scorching rays of the summer sun, and the hot, dry winds of the highlands; the moisture was dissipated, the

vegetation shriveled, while the streamlets dwindled and finally disappeared entirely during the summer months. With these changd conditions went the food of the young fry. The breeding trout failing to reach the old spawning places in the autumn were compelled to utilize the gravel beds lower down the stream, where the food of the young fry existed in but limited quantity.

Then with the melting of the snows came the spring rise, and with it the logs of the lumberman, plowing out the beds on the gravel bars, scattering the trout fry and killing many. In Michigan, in each recurring spring, the logs plowed up the spawning beds of the grayling, destroying the ova almost entirely for many seasons. To this cause, alone, is to be charged the almost total extinction of grayling in Michigan waters, and not to over-fishing. Neither have they been driven out by the trout, as has been alleged. Before the era of logging trout and grayling had existed for all time, and dwelt together in perfect amity.

The mining of metals and the smelting of ores can not be operated without water, consequently the streams in the neighborhood of mines become discolored and impregnated with deleterious matter that destroys, utterly, the food of fish fry, covers up the spawning beds with silt and debris, and eventually pollutes the stream to such an extent that but few, if any, mature fish can survive in them.

The offal from distilleries, and the sawdust from sawmills, likewise settles on spawning beds, so that if any fish eggs are deposited they are smothered and the embryo perishes. Chaff from the slop of distilleries and sawdust from the mills often become lodged in the gills of mature fish, causing inflammation and death.

Coal mining is also fatal to fish life, inasmuch as the washing of coal, as now practiced, not only discolors the water, but the coal dust is deposited on the spawning beds, and if breathed in by fish, old or young, clogs the gills, and from the well-known hardness of carbon, irritates and inflames them.

The waste matter from oil refineries, paper mills, starch factories, etc., where poisonous chemicals or noxious substances are used or occur as by-products, is very destructive to fish of

all ages, and is a more potent factor in the destruction of fish food than any agency mentioned.

All of you are doubtless familiar with the loss of fish life from the causes enumerated, but there is a source not generally suspected that is the cause of untold havoc and destruction, whereby millions of fish and fry perish annually. This is all the more lamentable as it could be so easily prevented. I allude to the wholesale destruction of fish life through the operation of irrigation ditches. It is very discouraging to fish culturists in the western states, after hatching and rearing fry and yearlings with much care, labor and solicitude, to have them stranded on the meadows and grain fields of the selfish or thoughtless rancher. It seems to be impossible, by argument or reasoning, to impress the average legislature in the west of the importance of screening irrigation ditches at the intake. The only objection raised is that it would be too much trouble, or take too much of his time, for the rancher to keep the screen clear of leaves and trash. This objection, however, is a mere subterfuge, for during the season of irrigation in the summer the streams are free of trash.

But to meet and overcome this objection I devised a very simple affair, as some of you may know, that would be just as effective in keeping fish out of the ditches as a screen, and one that would need no attention after being put in place. It is an eight-bladed paddle wheel of simple and inexpensive construction, to be placed in a short flume at the intake of a ditch, with enough fall to create sufficient current to operate the wheel. No fish will pass it while it is in motion. Its cost is but little, if anything. But were its use compelled by law it would deprive the rancher of his winter supply of salted trout, and of a valuable fertilizer in the shape of trout fry.

I have made two efforts to have the use of the device made compulsory by incorporating such a provision as a section of the game and fish laws of Montana. But both times the committee on game and fish cut it out for the reason that it might jeopardize the rest of the pending bill, the principal feature of which seemed to be to create a fund for the payment of the game wardens. As the present law now stands, a resident of Montana must procure a license to fish, and pay for it; but in-

asmuch as the same law provides no adequate protection for fish, this tax is generally looked on with much disfavor.

The only protective measure for fish in Montana is that the sale of trout and grayling is illegal. Were it not for this provision the average rancher would have a cinch, for the town markets would be glutted during summer and fall with trout and grayling scooped out of his irrigation ditches.

In view of the extensive schemes of irrigation contemplated in the arid regions of the west by the national and state governments, the proper protection of fishes should be provided for in advance; after awhile it will be too late. Last month a big irrigation canal, constructed by the government, was opened, having its source in the Truckee River, in Nevada. Government and state officials were present to celebrate the event. One account says:

"The gates of the dam were lowered and those of the canal were raised, the great flood pouring into the huge ditch. The reclamation project in Nevada was then formally dedicated. When the gates on the river dam were lowered the bed of the stream below was dry. In an instant the party found diverting sport in catching the large trout that were floundering on the rocks."

The protection of fish by law in many states is mostly on paper. Taking fish during the spawning season, or by means of nets, the spear, and dynamite, and the slaughter of the innocents by the conscienceless angler, are not rare occurrences. In some states where the laws for the protection of game-birds and mammals are rigidly enforced, and but little illegal shooting is done, the laws for the protection of fish are frequently violated. It is popularly considered not so great an offense to take a trout or a black bass during the close season as to shoot a quail or grouse when prohibited by law.

In the older states, where game-fish have become scarce, there is now a disposition to provide stringent laws for their protection, another instance of locking the stable door after the horse is stolen. But on the other hand the equally important matter of protecting the water itself, and the fish food in it, is seldom thought of or sadly neglected. It is popularly supposed that fish should abound, thrive and multiply, wherever there is

a reasonable amount of water, even if polluted or contaminated by deleterious matter which is destructive of fish food, if not of the fishes themselves. Sometimes the mistake is made of dumping fry or yearlings in the main body of streams or the open water of ponds or lakes, where but little fish food exists, and where they are soon taken in by the larger fish.

It has been said that the proper way to train a child is to begin with its grand-mother. So the proper way to protect fish of inland waters is to begin with the water itself. Practicable fish-ways should be placed in every dam or other obstruction. Manufacturing plants and mines should be compelled by law to construct settling ponds for waste liquid products, so that the overflow would consist of comparatively innocuous water. In all states where irrigation is practiced, laws should be enacted providing for some effectual device for keeping fish and fry out of the ditches. Close seasons for all game—and food-fish during the breeding seasons, should be established, and severe penalties should be exacted for the violation of such laws. Every peace officer, or officer of the courts, should be made a game and fish warden with full powers, in addition to the regularly appointed wardens.

The sewage of towns and cities is another problem that will have to be dealt with eventually, though at present it receives but little attention. If these things can be accomplished better in the future than they have been in the past, and more care be taken in stocking waters with fry or yearlings by depositing them in the smallest tributaries, or shallow, protected places, where there is a reasonable amount of food suitable for them, we will be on the road toward a better state of things, so that by the continual stocking of waters with fish artificially propagated, a fair amount of fish life may still be maintained in inland waters.

I consider that it should not only be the privilege and pleasure, but the duty of this Society, individually and collectively, to employ every means to educate the people to a proper sense and appreciation of protective measures, not only for fish, but for the waters as well, and to use its influence in shaping such wise, adequate and effectual legislation as may be necessary to that end.

As the Department of Agriculture has begun the good work of protecting and conserving our game-birds and mammals, the question naturally arises: Why should not Federal protection be extended to our fishes in public waters? I can imagine no good reason why the United States Bureau of Fisheries should not take an active interest in preventing the pollution of public waters, and in protecting the fishes that inhabit them. In anticipation of the extensive irrigation projects contemplated by the general government in the western states, the influence and timely action of the bureau would prevent the almost total depletion of the streams of fish life which would otherwise surely follow.

DISCUSSION.

President: In the report of Dr. Henshall's paper read yesterday at the hatchery, Mr. Clark has discovered what he claims to be some inaccuracies, and he would like to state them and have them corrected, so as to have it go into the published proceedings all right.

Mr. Clark: It is unfortunate that the paper of Dr. Henshall on "The Protection of Fish in Inland Waters," could not have been read in full before the meeting. It was read before the gathering down at the hatching station, when very few were present, and in fact I believe part of the paper was not read at all. Since that time I have had the privilege of reading his paper, and after going over it quite carefully, I think it worthy of very careful consideration.

Dr. Henshall says in his paper: "In Michigan, in each recurring spring, the logs ploughed up the spawning beds of the grayling, destroying the ova almost entirely, for many seasons. And to this cause alone, is to be charged the almost total extinction of the grayling in Michigan waters, and not to over-fishing. Neither have they been driven out by the trout, as has been alleged. Before the era of logging, trout and grayling had existed for all time." I wish to call attention to the fact that in printing the paper that way without making any explanation, it would seem as though the Michigan and the United States Fish Commissions had practically nothing to do with these streams, so far as stocking is concerned. It is not a fact that the grayling

streams had trout in them. In my first fish cultural work thirty years ago, the streams that contained grayling were barren of trout, and the latter were not there until planted. I want to emphasize the fact that the best streams today in Michigan are those that have been stocked by the state and Federal Fish Commissions. That point I want to bring out clearly.

Dr. Henshall further says: "All of you are doubtless familiar with the loss of fish arising from the causes enumerated, but there is a source already suspected whereby millions of fish and fry perish annually. This is all the more lamentable as it could be so easily prevented. I allude to the wholesale destruction of fish life through the operations of irrigating ditches."

And further on: "As the Department of Agriculture has begun the good work of protecting and conserving our game birds and mammals, the question naturally arises: whether or not federal protection should be extended to our fishes in public waters. I can imagine no good reason why the United States Bureau of Fisheries should not take an active interest in preventing the pollution of public waters, and in protecting the fishes that inhabit them. In anticipation of the extensive irrigation projects contemplated by the general government in the western states, the influence and timely action of the Bureau would prevent the almost total depletion of the streams of fish life which would otherwise surely follow."

I think that this society ought to take some official action, now that the irrigation matter has been taken up so extensively, to urge upon the various states and the national congress to do something along the line of fish protection. I can see the point Dr. Henshall makes further back about the gates being opened and the trout rushing down and scattering out and all dying. He gives a plan there that he thinks will remedy the difficulty easily, and I believe it is a matter that should be thoroughly investigated. Undoubtedly in time an effort will be made to remedy the trouble; but it is urged that something be done now, before the streams are greatly injured.

Mr. Fullerton: I suggest that Mr. Clark present a resolution to be acted upon in that line.

Mr. Seymour Bower: I wish to endorse all that Mr. Clark

has said in regard to the distribution of trout and grayling naturally, in the state of Michigan. The inference to be drawn from Dr. Henshall's paper, as I understood it yesterday, was that the trout and grayling inhabited the same waters indiscriminately. According to our best information that is not true. The trout belt and grayling belt of Michigan were clearly defined. The great natural trout belt of Michigan was the upper peninsula, and there is today and never has been but one grayling stream in the upper peninsula, viz., Otter river. The great natural grayling belt was in the lower peninsula; and these streams contained no brook trout. Those that contained the grayling had no brook trout naturally, except possibly a few where the dividing lines nearly joined; but practically the grayling streams contained no trout, and vice versa. Today, of course, grayling are practically extinct, but the streams are all now strictly first class trout streams, made so through the introduction of fish from the hatcheries.

Mr. Titcomb: I want to ask a question on that point. Was the depletion of the grayling caused by the introduction of the trout?

Mr. Bower: That is a mooted question. Dr. Henshall says it is principally through the running of logs destroying the spawning beds. But the introduction of trout is a factor at least. Of course the introduction of any kind of fish where there is only one variety, as there was practically in the case of grayling, would supplant the single variety to a greater or less extent. My own opinion is that those streams will never be restored as grayling streams because they are stocked with trout.

Mr. Titcomb: On Mr. Clark's reference to Dr. Henshall's paper, and the effects of irrigation on the fishing, I think that matter is just as important as the protection of the Yellowstone Park, and I think there should be some action, state or national, or both, in that respect; and I believe that a resolution should be drawn by the resolutions committee on that subject. I get reports from other sources than those to which Dr. Henshall has access, from other superintendents and persons applying for fish; I note that the irrigation situation is growing worse and worse every year, and extending from one place to another. Even

in Colorado where the trout has obtained such a foothold since the artificial propagation has been taken up there, we face the evil results of irrigation. The stock of blue back salmon has disappeared from the Columbia river, a fact which is largely due to irrigation in the head waters. Dr. Evermann can vouch for that.

Dr. Evermann: I think that is true, although I have made no personal observation on that point; I have been told by people in various places in the Snake River Basin, that the young blueback salmon go down during the spring floods, and in immense numbers run up into the irrigating ditches; and I know the same thing to be true in certain places in Colorado as to trout; but as to the fact regarding the blueback salmon, I am not personally conversant with them, though I have no doubt that irrigating ditches in the west are a very serious factor in the destruction of the various Salmonidae in that region.

President: It seems to me that the importance of this subject requires especial attention. Perhaps the committee on resolutions have not time to take this thing up and present it in shape to be effective. It seems to me that there should be a special committee to look into that matter and draw strong resolutions. If the committee on resolutions have the time and can get the testimony they want and incorporate it, that is all right; but I have heard no motion to take the matter up and refer to the committee on resolutions.

THE GOLDEN TROUT OF VOLCANO CREEK.

BY DR. BARTON W. EVERMANN, OF WASHINGTON, D. C.

I shall take but a few minutes to tell something about the Golden trout of Volcano Creek, California. There was not very much known about this very interesting species of trout until recently. Up to 1875 nothing whatever was known regarding the trout of the Southern High Sierras. In that year certain specimens were collected from the south fork of the Kern River, and identified as the common rainbow trout. Nothing more was known from 1875 until 1891, when members of the Biological Survey of the Department of Agriculture and certain gentlemen living at Lone Pine, in California, collected specimens of trout in this region.

The locality is southeast from San Francisco, 250 to 300 miles. It is the culmination of the High Sierras, Mt. Whitney, the highest mountain in the United States, being within this region; and the streams to which I have referred nearly all have their headwaters in and about Mt. Whitney and its neighboring peaks. Just over the divide is Owens Lake, in Inyo county and east of Tulare county. Volcano Creek is due west from Owens Lake.

In 1891 certain gentlemen at Lone Pine collected specimens of a trout and sent them to the Nevada State Fish Commissioner, who forwarded them to the California State Fish Commissioner, San Francisco, and they finally fell into the hands of Dr. Jordan of Stanford University, who described the fish as a nw species.

Nothing more was known of the fish until recently. Two years ago, Stewart Edward White, the author of the "Blazed Trail," called the attention of the President to the trout of Volcano Creek, and the ease with which it might be exterminated. He stated to President Roosevelt that this trout is found only in one creek; that while it is abundant in that one stream, the number of tourists who go in there each year will be sufficient, unless some precautionary measures are taken, to exterminate

the species. And as he thought the extreme beauty and gameness, and interesting features of this trout, merited that it should receive some protection, he urged that this protection be given. In response to these representations the President of the United States asked the Commissioner of Fish and Fisheries to have some inquiries made regarding the golden trout and the possibilities of its extermination; and it was in carrying out the commissioner's wishes that I had opportunity to go into this region a year ago.

The Kern River region is exceedingly interesting in its hydrography. There is one large river, the Kings, flowing west; another, the Kern, flowing due south for many miles of its course; and bisecting the angle between them, is the Kaweah River, flowing to the southwest. We went up the south fork of the Keweah River, examining it in different places, finding trout, and finally coming to the headwaters of the tributaries of the Little Kern, where we found trout not previously collected by anyone. Then we went over the Western Divide of the Sierras to Kern Lake, and there obtained specimens of the Kern River trout, a species of rainbow that had been known since 1893, and a very beautiful species it is. From there we went up Kern River, crossed it and followed up Volcano Creek, formerly called Whitney Creek, on the supposition that it had its headwaters on the slope of Mount Whitney, but that was a mistake. The name Whitney Creek was then transferred to another creek, which rises on the west slope of Mount Whitney, and the other creek was given the name "Volcano Creek," which had been applied to it to some extent before, owing to the presence of some five or six small volcanic cones along its course. From Volcano Creek we went north and followed up Whitney Creek to its head and examined other streams and lakes further north.

Kern River flows through an exceedingly deep canyon, having from 2,000 to 4,000 feet of wall on each side. It also flows exactly south for a number of miles of its course. The streams which come into Kern River from the east and west, come down from the high mountain plateau on each side and drop into Kern River over considerable falls. In nearly all instances the falls are so great as absolutely to prevent the ascent of fishes.

Those falls, of course, through the wearing down of the rock, have come into existence gradually, and such of these lateral streams as are peopled by fishes were doubtless stocked before these falls became impassable. But in some instances the falls became impassable at once, before the streams were stocked, and as a result there are no trout or fish of any kind in many of them. In fact, the majority of the east and west tributaries are entirely without fish, although every indication points to the fact that they would be exceedingly well adapted to trout. And this is one of the good fields for fish cultural work, either by the Bureau of Fisheries or the state of California, that is to say, taking fish from streams where they are found and planting them into these barren waters.

On the west side of Kern River is the Little Kern, which has trout in a number of its tributaries. We found them in Soda Creek, a small stream, and learned that they had been transplanted by ranchers over to the headwaters of the south fork of the Kaweah, and we found the trout in these two places identical.

On the east is a stream called the South Fork, and just north of it is Volcano Creek, the stream of most interest to us, flowing nearly due south, and then making an abrupt bend to the westward. At the point where it makes a bend to the westward it comes within a few rods of the south fork of the Kern, but there is a broad alluvial ridge separating them now. Volcano Creek drops into Kern River canyon over at least three very considerable falls, ranging from eighteen feet to sixty-three feet in height, and it is impossible for fishes to get up over any of them.

Throughout the entire length of Volcano Creek is found this golden trout of Volcano Creek. Doubtless the trout of that creek came originally from Kern River, and it will interest all of you, I am sure, to compare the Kern River trout, the Volcano Creek trout, and the one from Soda Creek. The Kern River trout, or Gilbert trout, is profusely spotted throughout; it has a rich, rosy wash on the side. Between the rami of the lower jaw there is sometimes a slight wash of red, but ordinarily not. The important point is that they are so profusely spotted all over, with the anal, dorsal and ventral fins white tipped,

somewhat as in the common brook trout, but it is not a *Salvelinus,* but a *Salmo.*

In Soda Creek and other tributaries of the Little Kern, and perhaps some other streams on the west side of Kern River, is found a species which differs very materially from the Kern River trout. However large the individual may get, they always retain the parr marks, but the spotting is not nearly so abundant as in the Kern River trout, although it extends the full length of the side above the lateral line, covering that completely, and below the lateral line to perhaps half way down the side of the body. The lower half of the side of the body is a rich lemon or orange color, and the belly has a very broad rich orange or cadmium band. It is a small creek fish which never reaches a large size. It is not related to the Dolly Varden.

Secretary Peabody: What is the extreme size of the Kern River trout?

Dr. Evermann: The largest one I caught weighed three and a half pounds. It is a splendid game fish, and it puts up a great fight. It is said to reach a weight of seven or eight pounds.

On the east side in the South Fork of the Kern, is the fish that President Jordan described several years ago, which is very much like Soda Creek trout, with no spots below the lateral line, but is spotted above the lateral line.

Then there comes the *real* Golden Trout found in Volcano Creek, which has scarcely any spots anywhere. The dorsal and caudal fins are profusely spotted, as in all the other cases, but on the body typically there are no spots, excepting on the caudal peduncle, extending no further forward than the adipose fin. The rest of the body and head are entirely without spots. The Parr marks persist in specimens eleven and a half and twelve inches in length, that I have seen. The scales are exceedingly small, smaller perhaps than in any other known sepcies of trout, although the counting does not show it, but that is because the scales are not imbricated, but separated with interspaces between. But even allowing for that, there are at least 200 in a series along the middle of the side. Then the richness of the side, and the extreme richness of the broad cadmium band on the belly, are worth nothing.

Now just a few words regarding the fish cultural value of this golden trout. In the first place, as I have already said, it is an exceedingly beautiful trout. In the second place, it is an exceedingly game fish. Unfortunately it will take any sort of lure, and therein lies the danger of its extermination. Many camping parties go into the Kern River canyon every season. While I was on the creek a period of two or three days, there were several parties, composed of from two to eight people, encamped on the creek. They were fishing all the time, and I was sorry to see in the "Outlook" that one man, who should have known better, as he is professedly a friend of game and fish protection, admitted that his party of three ate sixty of these fish for supper. That is more than our entire party of ten people took in three days for table purposes and for specimens.

Secretary: What is the temperature of the water?

Dr. Evermann: About 53° to 55° F., when we were there, just a year ago to-day.

The golden trout is a hardy fish. Some years ago the California Fish Commission took a number of specimens out by pack train from the creek, a long day's pack down the Lone Pine, and then by rail around to San Francisco, to the hatchery at Sisson, and they reached there with scarcely any mortality. But soon after the fish reached there they died on account of defective water supply.

Last spring a Sportsman's Association of San Francisco, which was having an exhibit, sent a man to Cottonwood Creek, and he got forty or fifty specimens of the closely related species found there; and they reached San Francisco without the loss of a single individual, and remained in the aquariums there for several weeks, without loss, and finally were taken to the hatchery at Sisson, where some of them still remain. The Bureau of Fisheries made an attempt last spring to get trout out from Volcano Creek for the Portland Exposition, but an accident happened to the fish after leaving Lone Pine, and the attempt was unsuccessful. But everything that we do know about the golden trout, indicates that it is a hardy fish and can be transported easily, and no doubt would do exceedingly well in our smaller mountain streams, particularly in various places in the west. I do not know if it would do so well in any of the New

England streams, but it would be exceedingly interesting, I think, to take some of the fish from Volcano Creek, and make a plant of them in some small mountain stream in the east, and note the effect it would have upon the coloration. Of course the peculiar colors of the fish are due largely, or wholly, to its environment, and the environment of its ancestors. Volcano Creek is made up largely of granite sand, gravel, volcanic sand, and volcanic tufa, which resulted from various volcanic eruptions occurring here, all of which have a yellowish white color, and in many places the bed of the stream is yellowish white, and when these fish are lying close to the bottom it is sometimes difficult to extinguish the fish if it is quiet, from the general color of the bottom. But that is what you would expect, as just such factors as those have had much to do with the colors of all fishes and other animals.

There are two ways of getting to the Kern River. A good way is to go by the Southern Pacific, or Santa Fe to Visalia, then by stage to Redstone Park or Threerivers, and outfit there. If you go for angling you will get two or three introduced specimens, the common rainbow, the Shasta rainbow, and the cutthroat trout, also the Soda Creek trout, the golden trout of Volcano Creek, and the golden trout of the South Fork of the Kern. You will find a larger number of fishes, and in a setting perhaps not surpassed anywhere in the United States, for beauty and grandeur.

I should like to repeat again, and there is no field that I know of where fish cultural operations can be extended to better advantage than in the headwaters of the Kern, and certain headwaters of the Kaweah and Kings Rivers. There are large numbers of small mountain streams, and high mountain lakes, which are well supplied with trout food, and which are now entirely without fish of any kind, and these regions are sure to come into greater and greater prominence year by year, as more tourists go there.

Ordinarily it is said that it does not rain in this region in the summer time, and we went in taking that statement at its face value; but it rained on us every day for fourteen days, but fortunately the majority of the rains were not heavy enough to cause us inconvenience.

A report upon this golden trout and its relatives, will be published by the bureau shortly.

(Great applause.)

DISCUSSION.

Mr. Clark: As Mr. Ward Bower is here, and as he brought out the trout to take to the Portland Exposition, I would like to have him describe to the Society, how he brought those fishes from the creek to the railroad point.

Mr. Ward Bower: Mr. President, I do not know that I can say anything of interest in this matter, as I had no intimation that I was to be called upon, but in company with a party that camped on Volcano Creek this spring, we had no difficulty in catching the trout with hook and line; in fact, one man went out in three hours fishing in the forenoon took 166 with a hook and line, with a small piece of bacon for bait. They would take most anything. Even a bare hook, I am quite sure, would catch the golden trout at times. We first attempted to take them in a seine, but were not successful. We found no difficulty in holding them. Our object was to obtain eggs, but we found we were too late. The fish had spawned.

There is a direct trail from Lone Pine over to Volcano Creek —a distance of thirty-four miles, to where we established our headquarters, but owing to the height of the pass, about 11,000 feet, where it is necessary to cross in order to take this direct trail, and to the depth of the snow (this was on May 25th) we were forced to take a roundabout trail, requiring four days' time and a journey of sixty miles, crossing the divide at an elevation of 8,000 feet. Although supposed to be the easier though longer trail, it was necessary to make numerous detours on account of the snow and the bogs.

After getting fish and holding them for a time, and finding it impossible to obtain eggs, we started down for Lone Pine with them, by the direct or shortest trail, the object being to transport them to Portland for exhibition purposes. We had rectangular pack cans that were made especially for carrying fish by pack train, loaned by the California Fish Commission. The train included five men, ten animals, a live car, cans, etc.

The cans held about nine gallons each, and were carried two

cans per mule, one suspended on either side. In each can we placed fifty to seventy-five specimens; on an average they were eight or nine inches in length. We started one morning from Volcano Creek, and the first day traveled eighteen miles, camping that night on a small stream. Here the fish were transferred to the live car, which was placed in the stream over night. The next day, after an unusually difficult half-mile climb to get out of the creek canyon, we continued our zigzag course down the mountains, descending about 6,000 feet the first ten miles, and arriving at Lone Pine that night. We lost ten trout on the journey. It was necessary to change the water occasionally, and also to add snow to keep the temperature down. The sun was very warm during the middle of the day, although the altitude was still high.

One of the cans was covered with three thicknesses of burlap and kept wet. The temperature in this particular can averaged six degrees colder than the others throughout the entire journey. Perhaps some insulation of this kind may be of use in transporting other kinds of fish.

We experienced some difficulty in the loss of water from the cans, some of which had only a screen wire cover. The country being very rough, the water splashed out and had to be replenished whenever possible. I would advise, in the future, the use of a tight cover with perforation. We delivered the fish in good condition to a messenger of the bureau, who started with them for Portland.

THE PROBLEM OF LOBSTER CULTURE.

Experimental Work of the Rhode Island Commissioners of Inland Fisheries.

BY A. D. MEAD, PROVIDENCE, R. I.

Some years ago the Commissioners of Inland Fisheries of the State of Rhode Island began an investigation of the problems connected with the growth, distribution, and abundance of lobsters, clams, and other shell and food fish of the state. For the last five years particular attention has been paid to the lobster, as the lobster fisheries of the state are exceedingly important and at the same time so extensive as to threaten the total extermination of this delectable food animal.

At the suggestion of Dr. H. C. Bumpus, then one of the members of the Rhode Island Commission, an attempt was made, partly in collaboration of the United States Bureau of Fisheries, to rear lobster fry in sufficient numbers to preserve, or if possible to increase, the supply of lobsters.

For a long time the hatching of lobsters has been carried on artificially by the United States Bureau of Fisheries, but attemps to rear the fry to a size where they can protect themselves and stand some chance of surviving when put overboard. have repeatedly been considered by fish-culturists and biologists, but appeared to present insurmountable difficulties, as all attempts to retain the fry for any length of time in the hatchery proved futile, the mortality being exceedingly rapid.

It hardly seems as if the mere hatching of the eggs would at all increase the number of lobsters, in fact it almost seems as if it would be better to allow them to hatch naturally. The eggs have few enemies, are well protected when attached to the underside of the female lobster, and have every chance of hatching into fry. But the early stages of the fry are unprotected, they swim at the surface and are eagerly sought after by nearly every fish that swims. The real problem of lobster culture is to protect these early fry, to rear them to a stage where they seek the bottom, and hide under stones and weeds, and burrow in the gravel, where they are protected from their enemies and stand

a chance to grow into adult lobsters. In this way only can we hope to decrease the usual natural mortality which is estimated amounts to about 999 in every thousand. This was the problem laid out for the Commission by Doctor Bumpus, and this is the problem which has been carried out to a successful solution.

As has already been said the eggs need little or no protection except from man. The mother lobster securely fastens them to the appendages of the under side of her body, carries them safe protected for many months, continually aerates them by the movements of her appendages, and as they slowly hatch, scatters them widespread as she moves about from place to place. Most states recognize the importance of protecting the egg-bearing lobsters. Laws are on the books imposing a penalty for taking, having in one's possession, or selling them, and if a careful inspection by deputies with power of arrest and prosecution is made, a certain protection will be afforded. It is needless to say that at the present time the strict enforcement of these laws is impossible and that many of the short and "egg" lobsters caught, are not returned to the water.

The newly hatched fry, however, are at once the victims of circumstances. They float helplessly about with every shifting current. Everyone who has studied the subject at all has admitted that the early stages of the fry are the critical stages of a lobster's life, and could they be protected and permitted to grow to the stage where they change their habits, seek the bottom and burrow in the sand, the problem of the lobster culture would be solved.

The little lobster which hatches from the egg begins to eat immediately, grows but little until it is about three days old, when it sheds its skin and becomes a considerably larger second stage fry. It remains in this stage on an average four or five days when it moults and grows again and becomes a third stage fry. Again after five or six days it again moults and becomes a fourth stage fry. It is during this stage, that it changes its habits from a free-swimming larva and takes to the bottom to assume the habits of a full grown lobster. The whole process, varying with many factors such as temperature, food, etc., takes from eleven to twenty-one days.

The difficulties connected with rearing the fry to this later

stage are in brief, first, their terrible cannibalism, second, the difficulty of keeping them properly aerated and free from fouling from their decaying food, third, the supply of proper food, fourth, protection from a growth of diatoms and other vegetable and animal forms, which appears on the surface of their bodies and prevents them from swimming and feeding. To combat and overcome these difficulties one by one has been the work of the Rhode Island Commission for the past few years. I will try to review briefly how this has been done.

In 1898 Dr. H. C. Bumpus commenced a series of experiments at Woods Holl, and in 1900 some of them were transferred to the house-boat laboratory of the Rhode Island Fish Commission at Wickford. Up to this time a great many devices for enclosing the fry were tried, and proved to be impracticable, and the one which finally promised the best results was a scrim bag, suspended in the water so that the movements of the tide and wind would frequently change its shape and prevent the fry from collecting too densely in any one place. The meshes of the scrim, of course, allowed a free circulation of water through the bag; but even in this apparatus, when the weather was calm, the lobster fry, together with unused food, would settle into the pockets which were made by the weights necessarily used to keep the bag under water. When the weights were taken off, the least wind would blow the bag out of the water, and this was very trying to the young lobsters. Near the end of the season of 1900 a new principle was applied, on which has depended in a large measure the success of the subsequent work.

After the numerous experiments and watching the results for about five weeks, the conclusion was reached that the secret of success in rearing the young lobsters was to keep the water in continuous motion. This accomplishes two things: it prevents the fry from settling into pockets to smother or devour one another, and it keeps food in suspension, so that the fry can obtain it.

To prove the correctness of this conclusion with the material and apparatus at hand, it was decided to experiment with lobsters which were at that time in small bags. Accordingly the force at the laboratory was divided into watches, and the

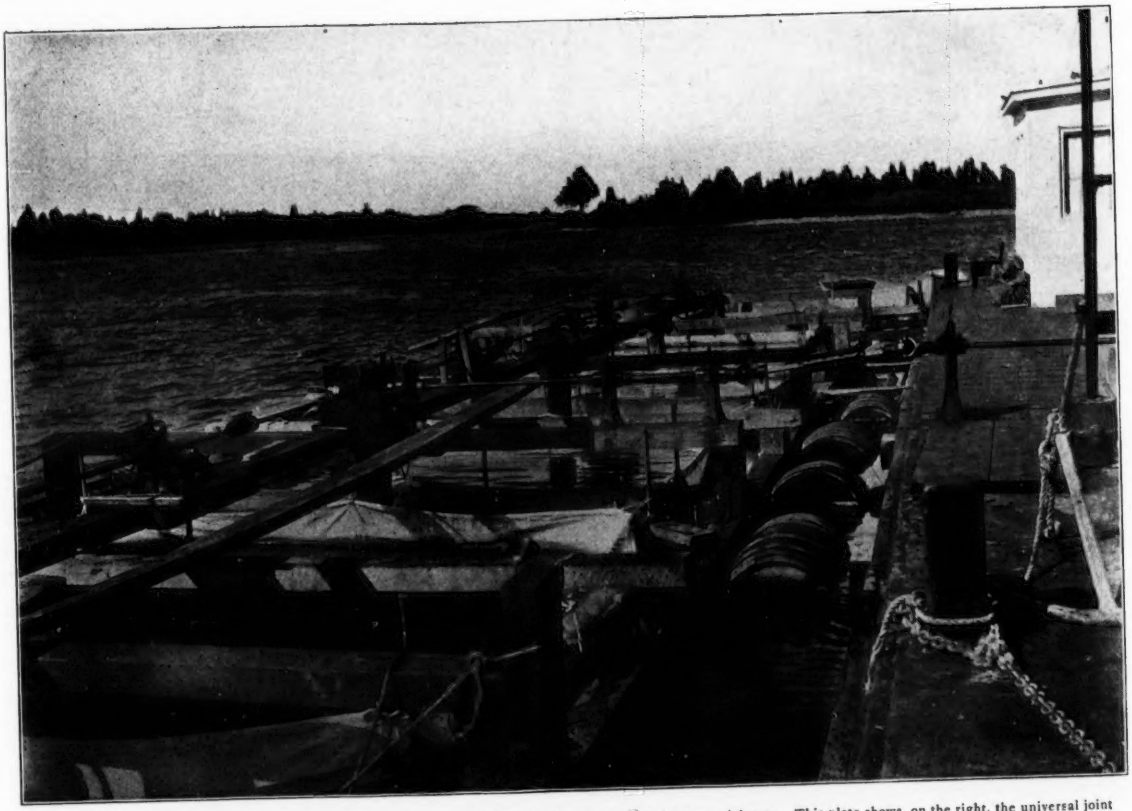


PLATE III.—Showing the appearance of one of the side floats containing the bags for raising the young lobsters. This plate shows, on the right, the universal joint by means of which the power is transmitted to the shafting of the float from the house-boat.

water in the bags was thenceforth stirred with an oar continuously for six days. The results was ample proof that the conclusion was correct. There were two lots of lobsters which received this treatment. Neither of these lots was considered to be as promising as the average. However, from one there was obtained 748 lobsters in the fourth stage. This is a larger number than were obtained in any other experiment, either at Wickford, Woods Holl or in any other station where lobster culture has been tried, so far is I am aware. From the other 319 were obtained in the fourth stage; but as one of the bags was old, and had a hole in it, the figures fail to give a correct idea of the results of the experiment. One of the most encouraging results of this method was the clean and healthy appearance of the fry in all stages. The continual stirring prevented the accumulation of parasites found on the body of nearly all of the specimens in the other lots.

During the following seasons this experiment was followed up with others, working upon the same theory, namely, that the water should be constantly stirred. To do this it was necessary to invent a mechanical device which would take the place of the oar and designs for such an apparatus were immediately made.

The mechanical device was put into successful operation in the season of 1901 at Wickford. The apparatus consisted of a number of rotating horizontal paddles, similar to those in use over restaurant tables for circulating air, one in each bag, run by a gasoline engine. The movement of the paddle blades created a constant upward current of water in the bags, which kept the fry off the bottom and kept the food suspended in the water. Through its use 9,000 lobsters were raised to the fourth stage, and in some experiments 50 per cent of the newly hatched fry were carried through to this stage. That this was a decided step in advance of the old methods will readily be admitted by those who have followed the course of previous experiments.

The apparatus now used (1905) comprises a house-boat between the pontoons of which are three small hatching bags 6 x 6 x 4 feet, made of canvas; two side floats constructed of 6 x 6 in. spruce beams bolted together and buoyed by barrels, each supporting five large canvas rearing bags about ten or eleven

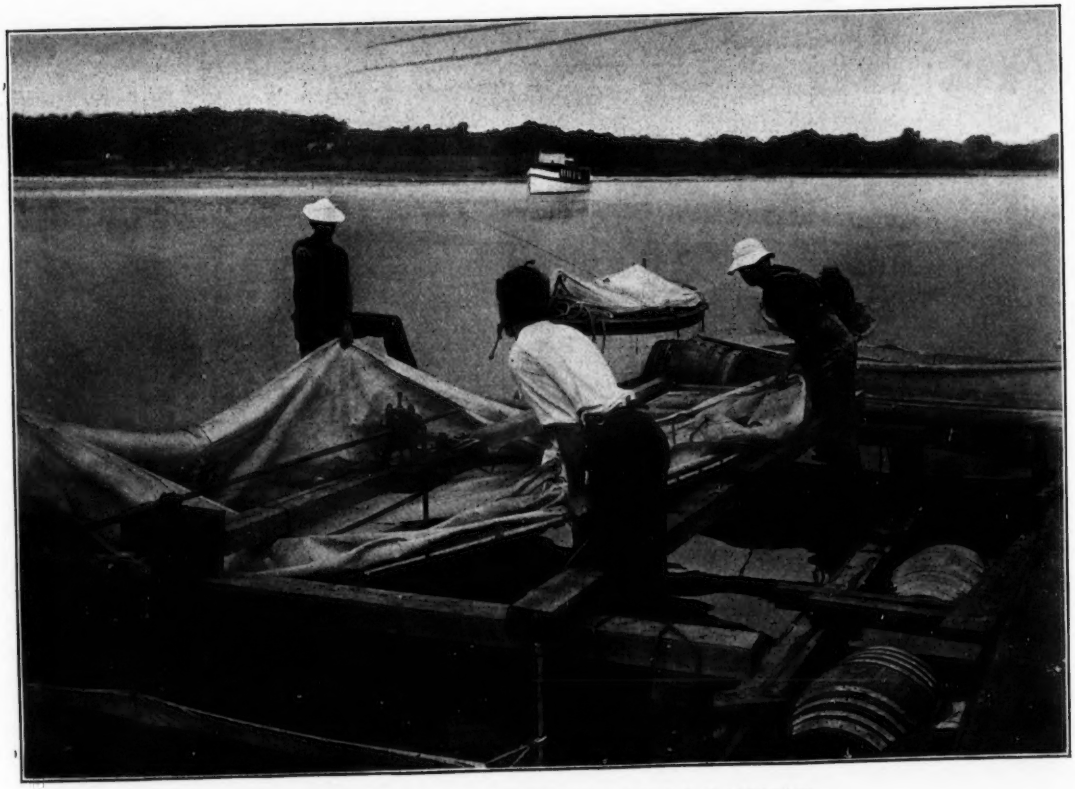


PLATE IV.—Shows the method of "putting down" one of the twelve-foot lobster bags.

feet square and four feet deep. Each bag has in it a two-bladed propeller, or "paddle," revolving about ten times per minute, which creates an upward whirling current of water strong enough to keep the fry and particles of food suspended. The vertical shaft of each propeller is geared to one of three longitudinal horizontal shafts; these, in turn, to a transverse shaft which is belted to a two-and-one-half horse power gasoline engine. Each paddle shaft can be thrown out of gear by a lever. The transverse shafts of the somewhat movable floats are coupled to the one running across the house boat by a universal joint and sliding shaft. The latter is a square shaft in two pieces sliding in a sleeve which is cast in two pieces for the sake of economy in manufacture. A drive of 75 feet of shafting is required to reach the farthest paddles, and the bed for the shafts is not, by any means, an example of modern "mill construction." Indeed the floats are constantly bending with the motion of the water, and also warp more or less. The shafts also are almost continually bending, but as they are comparatively light no trouble results from the lack of rigid construction and the transmission is very satisfactory.

The improvements in this phase of lobster culture, namely, that of hatching and rearing to the fourth stage, will, it seems to us, be mainly in the construction of the bags, the feeding of the lobsters, and the prevention of parasitic growth. The latter difficulty, however, is not so serious at Wickford as it was at Wood's Holl. Undoubtedly the percentage of yield can be raised by experimentation along these lines.

It is interesting to trace the actual results of these improvements in apparatus. In the year 1899 in the floating scrim bags at Wood's Holl Doctor Bumpus succeeding in rearing about one hundred lobsterlings to the fourth stage. This was one hundred more than had been reared to that stage previously by any method. In 1900 at Wickford 3,425 fry were reared to the lobsterling stage and 748 of these came from one experiment which was stirred with an oar night and day. This latter number was more than had been reared previously by the combined efforts at all other localities. With the mechanical device of 1901 the number reached 8,974; in 1902, 27,300; in 1903, 13,500; in 1904, 50,597. The total number for the pres-

PLATE V.—Shows some of the assistants working on a bag. One may be observed counting out fourth stage lobsters, another scraping the eggs from a female lobster preparatory to putting them in the hatching bags.

ent season, 1905, is 102,000; the entire total for all previous years is 103,796. The largest number reported from any other station is 3,750, reared by an apparatus of the same principle at Wood's Holl in 1902.

In ascertaining the number of lobsters reared to this stage the methods of estimating are not trusted, but the lobsters are counted one by one as they are dipped out of the water with a tea strainer fastened to the end of a stick.

It is obvious, of course, that the output of "lobsterlings" might depend upon the number of newly hatched fry available and on the extent of the apparatus. Taking these things into consideration the comparison is still more favorable to our station, for in most, if not all, other stations the supply of fry has been greater and the per cent of lobsters living through the three moults smaller.

The exact proportions of newly hatched young reared to the fourth stage can be ascertained accurately only by counting the number at the beginning and at the end of the experiment. The time required for counting is so considerable that only in few cases were the fry counted at the beginning of the experiments.

On June 7 and 8, 1905, 20,000 in the first stage were counted and placed in one bag. The "fours" began to appear in ten days and all that lived reached this stage before the end of the twelfth day. 9,635 lobsters in the fourth stage were counted from this twelfth bag; a yield of 48.1 per cent.

On June 28 and 29, 20,000 young fry, of the first stage, were counted into one bag. From this lot 8,178 in the fourth stage were counted; a yield of 40.8 per cent.

These two experiments illustrate very well the general results of the season's work, as there was no extraordinary care given them nor were they conducted under especially favorable conditions.

The proportionate yield is large as compared with that of other stations. The largest of these reported heretofore is 6.6 per cent.; Appelöf, of Norway, and 21 per cent. at Wood's Holl, where the Wickford apparatus was used. The 6.6 per cent was obtained as an experiment beginning with 1,500 fry in the

second stage. The 21 per cent was obtained in an experiment beginning with 3,000 (estimated) fry in the first stage.

A higher percentage has been obtained at Wickford with a smaller number; for example, 50 per cent. fourth stage lobsters were obtained from a lot of 1,000 in 1901, but in order to make the results practical they must be conducted on a larger scale.

The question of course arises are the efforts of the Rhode Island Commissioners in thus rearing and planting lobster fry apparent in an increase of lobsters in the waters of the state? The time has hardly come to answer this question. From our experiments it has been determined that it requires some five or six years for a lobster to attain a size of nine inches or more and the planting of fry has not been carried on as yet on a large scale for that length of time. However, in the vicinities where these lobsters were liberated, the lobster fishermen report that, for the last two winters young lobsters of about eight inches in length were abundant along the shore many of them being dug up by the clam diggers and by ourselves, and it is said that small lobsters have not been seen in abundance in these localities for twenty years. The lobster fry planted by this Commission should be about as large as these young lobsters by this time, and it seems probable that this large supply of young lobsters is the result of the efforts of the Commission. Again this past spring the lobster fishermen report a surprising abundance of young lobsters too small to be held in their pots. When the pots were pulled the little fellows scampered out between the slats. It certainly looks as though in a few years more, with continued efforts on the part of the Commission, the lobster industry of the state, now so dangerously near total extinction, might be rescued.

We feel that the efforts of the Rhode Island Commission have meet with success. There are many difficulties to be overcome, and many chances for improvement. Among the subjects to be further investigated is that of the proper food for the fry. We at present feed finely chopped clams. At Wood's Holl finely chopped fish was used. Neither one is a perfect food. With improvement in the food probably a larger percentage could be raised to the fourth stage and in less time.

The presence of a growth of diatoms and other organisms on the fry is another serious difficulty. The amount of this growth varies with different seasons. It can be partially overcome by proper shading of the bags. A warm temperature, clean water, proper aeration and circulation of water, proper food will so hasten development that trouble from this parasite growth will be largely eliminated.

There are many other problems connected with the latter stages of the lobster which are of great importance, both economic and scientific. The Rhode Island Commission has undertaken the solution of some of these. The habits and requirements of the young lobsters which have passed through the earlier stages, the rate of growth and age of lobsters up to the marketable size, the migration of adult lobsters along the shores and to and from waters of adjoining states, their migrations to and from deep water, the rate of growth of large lobsters, the extreme age to which lobsters may live and breed, the rate of moulting of the old and young lobsters, questions connected with the loss of claws or appendages and the relation of the growth of new claws or appendages to growth and moulting.

But these are problems for the future. It is sufficient for us at present that we have worked out a method of lobster rearing which enables us to hatch and rear lobsters on a large scale, is comparatively cheap, at least cheap enough to be practical, is capable of indefinite expansion and which will enable us each summer to rear a large number of lobsters to a stage where they will, when liberated grow into large lobsters in sufficient numbers to restock the waters of the state.

DISCUSSION.

During the reading of the paper by Dr. Mead, Dr. Gorham said:

Forty-eight per cent. of survival of lobster fray is about all that can be expected.

About half the young lobsters consume each other. With better food, however, the percentage of survival may be increased.

In the side and bottom of the box are wire screens to allow

circulation. The crates circulate in the water until the eggs are all hatched. The hatching is done direct in the water, the eggs are removed and the lobsters are fed at proper intervals day and night. In anywhere from eight to twenty-one days, varying with the temperature of the water principally, these fry pass through their successive changes, finally changing their habits when they reach the fourth and fifth stage, and are then ready to be liberated.

Dr. Smith: Do you consider it possible, with the apparatus now employed, to rear the fourth state, say 1,000,000 lobsterlings, without undergoing an expense that would be prohibitive? It seems to me that is the crucial question, as applied to this method which has been so successfully evolved by the Rhode Island Fish Commission.

Dr. Gorham: Without any great increase in expense, using the same horse power engine, simply by extending floats, and increasing the number of bags, we could extend the plant so that without very much difficulty we could rear in a season a million fry to the fourth stage.

Mr. Atkins: Would it not take an extra lot of men to operate those bags?

Dr. Gorham: I think the entire number could be easily cared for by the same number of men.

Mr. Titcomb: What do you estimate the cost of the present plant to be?

Dr. Gorham: The laboratory of the Rhode Island Fish Commission spends about $3,500 in a year in its investigations of lobsters, clams and other shell fish. The lobster season extends from the middle of May till the middle of July, or the latter part of July, and I should say that certainly less than half of the appropriation was devoted to the lobster work.

Q. Can you give me an estimate of the cost of the plant itself, aside from operating expenses?

A. I could not say offhand.

President: The expenses, including all the machinery and

everything connected with it, labor, food and salary of some of the men that are employed, are about $3,500 a year, and it has been divided up so that in any one year we have not had any great expense, nothing to exceed $3,500, probably about $3,000. In the first place we got the Marine Laboratory that cost us $1,000, and then as was necessary and these experiments called for it, we added gradually. To start right with a plant to hold a million lobsters, I do not believe it would cost over $5,000 for the plant, machinery and everything. You do not need a large house-boat. Ours only cost $1,000.

You must remember that all our work is not devoted to this one subject, and all this expense which is charged to the laboratory work is divided. We spend a great deal of time on the clam business. We have developed an industry there in which there is any amount of money commercially, if people will take it up. We have demonstrated practically that sea farming pays better than land farming. We have demonstrated beyond question that seed clams placed in the shore and protected, in fourteen months will become edible. When they become edible they sell readily at wholesale at $1.25 per bushel. We can raise from 700 to 1,500 bushels to the acre. That is quite a farm.

Then we have taken up the artificial propagation of fish to a limited extent there. We thoroughly investigated the Star fish in all its phases. We have been through all these things and worked them down to a final conclusion. The only thing we have not reached is about some diseases of fish; and I do not think anybody is going to reach that right away.

We have arrived at this point, that there is a great deal of interest in our state in the work we are doing. In our largest fair we made an exhibit last year called "Sea Farming" which attracted the attention of the public. This year they have asked us to make another, and we shall elaborate on the former exhibit.

We are doing a labor of love. We do not get anything for it. Even Dr. Mead gets nothing for his services; but we think we are going to do some good. New Zealand has appropriated £7,500 for fish farming; and has sent over for all of our plans and apparatus, and are going into it with that amount appropriated already. We have a good deal of correspondence from

all over. Men have been there from Germany, Japan, and all over, to visit this work, and it has attracted much attention; and we feel very proud of it. We do not want to blow our own horn, but hope you will get interested in this matter, especially those of you who are located on the sea shore.

I do not think the United States government could take hold of anything that would add more to the industries of this country than the work of growing lobsters. The lobsters are going, not growing.

One of the difficulties in a large plant would be to get the eggs of the lobster. We have an understanding with all the lobster fishermen, that if they will hold their egg lobsters we will buy them and pay them more than the market price, and then return the lobster to the waters. In Maine you can get any quantity of them, but on our coast it is difficult to get female lobsters.

Mr. Titcomb: The work of the Rhode Island Commission is most practical. That is a kind of scientific work that the world admires, and the practical results are admirable. I am asking these questions as a business proposition. As I understand it now, the statement that the plant cost originally $1,000, does not mean that the actual lobster hatching plant cost that much.

President: Oh, no, not by any means. Of course, to get this machinery was quite a little item, and required quite a little study on the part of Dr. Mead; and he had to work the whole plan out. Of course, it is not perfect yet by any means. I do not think he had a machinist there at all. He would think out an idea and go to some machine shop and have it executed and put it in there and try it. All experimental work, as you know, was a matter of delay, worry and effort, building up one thing on another—it is at that stage now. Dr. Gorham has been there only a short time, but he has done remarkably well and we think a great deal of him. The whole credit of this enterprise is really due to Dr. Bumpus. When he was in the employ of the United States Government he was also with our commission. He took hold of this matter and had an idea that the problem could be solved; and you know Dr. Bumpus goes ahead and

don't give up. We have only followed along on the lines on which he started us.

Mr. Titcomb: I would like to ask Dr. Gorham what percentage of fry he thinks he gets by allowing the eggs to hatch naturally on the lobster, as compared with the percentage which he would hatch by the artificial method?

Dr. Gorham: It is a little dangerous to attempt to estimate the proportion that can be hatched by the artificial method. We have tried a number of times to get an accurate estimate of the number of eggs hatched when they have been removed from the lobster. As near as I can figure it, 71 per cent. would cover the actual number hatched by that method.

We are sure, by experimenting, that the number of eggs hatched from the eggs while still on the lobster, provided the lobsters have been properly treated and not kept on ice till the eggs are killed, is something like 98 per cent. We can then rear approximately 50 per cent. of these fry to the fourth stage, where we are sure that a large number of them can care for themselves and grow into large lobsters. There can be no doubt of that. We have made a number of experiments in which we have counted the actual number of fry hatched from the eggs, and the actual number of fourth stage fry reared from those that have been hatched and with the apparatus as it stands at present, we know we can rear every time about 50 per cent. of the fry to the fourth stage, and we also know that with the same plant increased for the accommodation of a larger number of fry, without increasing the size of the house-boat itself, and without increasing the size of the engine, we can rear ten times that number of fry, without any doubt. And it seems to me that when we know the great possibility of these fourth stage fry living to reach the adult stage, and the great advantage that we have in planting fry of that age over planting fry that have been hatched directly from the eggs, there can be no question but what any efforts we can make to increase the number of these fourth stag fry that are planted, would be crowned with considerable success, and would certainly increase the number of lobsters in the waters where these fry are planted.

Mr. Titcomb: What would you do with 10,000 to 15,000

egg lobsters? Would you try to have the eggs hatch on them naturally?

Dr. Gorham: You mean in the season? We impound our lobsters through the winter so that we can have that condition during the spawning season. By shipping eggs on lobsters we rear a larger number than by stripping the eggs.

Q. Do you think it possible to do it on that stupendous scale?

A. Yes. We keep lobsters impounded until the eggs are near the hatching point, and so we would have a comparatively small proportion in number of lobsters in our crates at a given time. Those lobsters are kept in crates about forty-eight hours, when all the eggs will be found to have hatched into fry.

Mr. Titcomb: We keep these lobsters in pounds. When lobsters are impounded the eggs almost all hatch simultaneously. That is due to this large collection of lobsters being at an even temperature instead of being collected from various parts of the coast where they are in different temperatures. We find that the impounded stock gives better eggs than stock collected from fishermen along the coast at different places. But they all come out almost simultaneously. If you obtain the young lobsters in that way, would you undertake to rear to the fourth stage from 50,000,000 to 100,000,000 fry?

Dr. Gorham: We might have to vary our methods, provided a large number of eggs were at the hatching point at the same time. It might be better in that case to hatch the lobsters in a pound without rotating mechanism, and then collect the fry as they hatch, and place them in rearing bags. Some such scheme could readily be devised to take care of large numbers of eggs coming to the hatching point simultaneously. At the Wideford station we would have increased the output considerably if we had more egg-bearing lobsters. The number of egg bearing lobsters is small compared with the large number of frv which we carried to the fourth stage.

Q. Do you use a closed jar?

A. No. We have experimented with stripping lobsters and putting the eggs in the bags, but we find it better to hatch the eggs while still on the female.

Mr. Titcomb: We had some eggs hatched in open-top jars at Woods Hole, and experimented with them in two other stations, in comparison with the closed-top jar. Most of the superintendents consider the jars equally good, but object to the square aquarium into which the open jar empties, because of the dead space in the aquarium where the lobster fry, shells, etc., collect, and there the fry gets smothered or devoured.

Dr. Gorham: If the open-top McDonald jars could open directly into one of our bags with a rotating fan, it would solve the difficulty.

Mr. Titcomb: We have learned one other thing this last winter. Perhaps you have tried it. We have carried in live cars at the Woods Hole station, lobsters throughout the winter, which were collected in the fall of the year. That is the first time that has ever been attempted with us.

Dr. Gorham: We have reared lobsters from the egg until they were four and five years old, keeping each lobster in a separate compartment, sinking cars to the bottom of the channel, where they are free from freezing. Those were individual lobsters on which we were making observations for growth, moulting, etc. We have not kept lobsters throughout the winter on a large scale.

Mr. Titcomb: These were cared for, about 200 lobsters to a car.

Dr. Gorham: They fight so that I think it is better to keep them separate.

Mr. Titcomb: We lost some lobsters. Mr. Locke stated that he thought some had been stolen, as there was no remnant of lobster found where they had disappeared.

It seems to me this work is getting into a state where we all ought to take hold of it. The bureau ought to take hold of it and follow on, starting from where you now have it. But it

will be a tremendous proposition when you consider rearing to the fourth stage from 70,000,000 to 200,000,000 lobsters. We shall probably take 175,000,000 to 200,000,000 eggs on the Maine coast.

President: Let us have some of them.

Mr. Titcomb: The people on the Maine coast would rather have their lobsters killed than give them away.

President: I understand that what lobsters you take, the fry has to be returned to their waters.

Mr. Titcomb: That is the understanding and the law. Undoubtedly there are 200,000,000 or 300,000,000 eggs going to waste there every season, but the fishermen themselves will sell the female lobsters, stripping the eggs from them first, rather than sell them to us for the same price.

Dr. Gorham: In rearing lobsters to the fourth stage, the question of temperature is very important. In Maine, where the temperature is low, it takes twenty-one days to carry them through to the fourth stage, while at Wideford in July, it takes less than nine days to carry them through to the same stage. That would be an argument in favor of establishing rearing stations in the warmer waters. The temperature is an extremely important factor in determining the rapidity with which the fry go through their various moults.

Mr. E. D. Roberts: You have spoken about your fourth moult lobsters. I will present you with a fifth.

(Laughter.)

(Mr. Roberts referred to a little lobster pin which he was distributing.)

NOTES ON SMALL MOUTH BASS CULTURE AT THE NORTHVILLE, MICHIGAN, STATION.

BY FRANK N. CLARK.

In the Bulletin of the Michigan Fish Commission, No. 7, on "The Breeding Habits, Development, and Propagation of the Black Bass," by Jacob Reighard, a work prepared largely on observations made, and information collected in the spring of 1903, at the State Hatchery at Mill Creek, Professor Reighard says: "For some years efforts have been made, chiefly by the United States Fish Commission, now Bureau of Fisheries, Department of Commerce and Labor, and by the Michigan Fish Commission, to artificially propagate the black bass." "These efforts," he states, "have met with many difficulties."

This, as will be noted, was said two years ago, and so far as my observations go, the difficulties still arise, and must be overcome by the practical bass breeder. It is, I presume, conceded that with the large mouth bass, most of the problems in connection with their culture have been surmounted, and a considerable degree of success achieved. With the small mouth bass, however, so far as my investigations go, together with information from reading the works of others, it seems that there is much to be learned before arriving at a point of reasonable success, or where we can supply one-half the demand.

It is true that Mr. Beeman tells us, in his report for the years 1903-1904, to the Connecticut State Commissioners, page 28, that he estimated 400,000 small mouth bass fry were produced from a stock of twenty-five parent fish put in the ponds the fall before. It is probable that Mr. Beeman would revise his figures somewhat at the present time, or at least he would if he had the same kind of small mouth bass we have at the Northville Station.

The following are the breeding ponds in use this spring, with the area of each and the number of male and female bass placed therein:

	Area Acres.	Males.	Females.	Total.
Pond L.....	0.64	25	30	55
Pond O.....	0.60	30	34	64
Pond P.....	0.70	35	40	75
Total		90	104	194

On account of the backward season, the drawing down of the ponds in which the adult bass were held was delayed until later than desirable, being May 6, 7, and 8. It is thought that handling the fish so near the mating period had the effect of discouraging the spawning of many. Moving the parent bass from the ponds in which they are wintered, and transferring to other breeding or nesting ponds, is not thought desirable. Just previous to the spawning season each pond was provided with as many Lydell nests as the area would permit. The arrangement of the nests being very similar in all, only one pond will be noted.

Pond P, which was considered one of the most desirable as to available spawning area, was arranged with twenty-four artificial nests, as shown in the accompanying diagram, and represented by "X," while "O" designates the natural nests. The latter in the center of the pond were in from four to six feet of water, considerably deeper than the artificial, and furthermore, the natural nest in the center of the group produced the largest number of fry, yet was in the maximum depth of water above mentioned. Of the twenty-four artificial nests placed in this pond nineteen were cleaned by the bass and spawned on, and fifteen of this latter number hatched fry, fourteen of which produced fry ready for shipment.

It will be noted by the diagram that there were eight natural nests prepared, seven of which were spawned on and produced fry. Of the seven, two died before the fry were more than twenty-four hours old, making five the final result. Thus it will be noted that of the total number of nests in the pond on which eggs were deposited, namely twenty-six, nineteen furnished fry for distribution or holding for further development. These were estimated at 85,000 in number. There were taken out of this pond 35,000 as fry and distributed to applicants,

X, Fish produced, artificial nest.

O, Fish produced, natural nest.

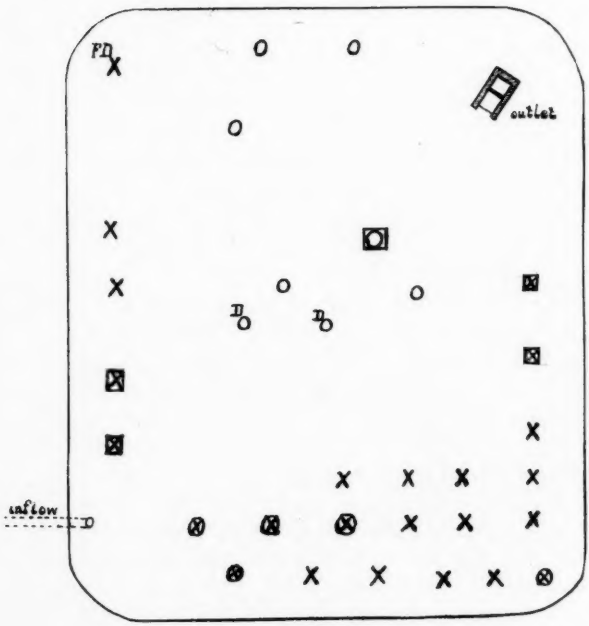
⊗, Artificial nest not used.

⊡, Natural nest cleaned but not used.

⊠, Eggs died, artificial nest.

ⱭO, Eggs died, natural nest.

FD X Fish died, artificial nest.



20,000 were placed in Pond M for rearing, and an estimated number of 30,000 left in the pond. Since then it has been drawn down, and 10,500 fingerlings, actual count, taken out. These fish were from one to two and one-half inches long, samples of which are before you.

The following extracts are made from the daily record of observations more particularly affecting the pond we are endeavoring to follow:

May 5, 1905.

Twenty-four artificial nests placed in Pond P.

May 6, 1905.

Forty females and thirty-five males put in pond.

May 10, 1905.

Today's examination showed ten artificial nests cleaned up nearly ready for eggs; temperature of water 59° F.

May 11, 1905.

Water dropped to 52°, caused by cold hard rain. Spring water turned on, creek water being very roily.

May 13, 1905.

Creek water warmed to 62°; almost clear. Valves, therefore, changed, and it was again turned into pond, being considerably warmer than the spring water. Male bass cleaning up more nests.

May 15, 1905.

Water very clear; temperature 64°. Examined nests and found that nearly all had eggs on. Several natural nests cleaned up.

May 17, 1905.

Examined nests in Ponds L, O, and P, and as a result forty-five with eggs on were found. Some fungus appears on older nests. Temperature of water 63°.

May 18, 1905.

Temperature dropped to 59°; cold rain; not severe enough to roil water to any extent.

May 21, 1905.

A few fish hatched; first of the season. Temperature of water 62°.

May 26, 1905.

Eggs all hatched, thus making the spawning and hatching period eleven days, in a mean temperature of 63° Fahr.

The nests were nearly all screened on the sixth day after hatching, and on the seventh and eighth days the fry had risen to the surface, and the distribution was commenced. Temperature of the water at this time was 69°. Very few were put out as fry, and this in not to exceed a period of five days, for thereafter the fry requiring food it is necessary to discontinue the distribution. At this point it might be well to say that the distribution of small mouth bass as fry is not considered advisable where they are to be in transit to exceed ten or twelve hours.

The young bass begin to change in color from the black to a mottled green in from ten to twelve days after rising, in a temperature of about 70°. This latter was registered by the thermometer during June and the fore part of July, with an occasional day when it reached 80°.

In summing up the observations and experiments in connection with Pond P, the question naturally arises as to why certain artificial nests were left, and natural nests, in deeper water, cleaned up and used instead. Also why did the eggs die on four of the artificial nests, and again why did the fish die on two natural nests and on one of the artificial. In my judgment all of these questions are to be answered by saying the fish were handled too near the time of spawning. No fault whatever, could be found with the fish at the time of moving from the ponds in which they had been through the winter. They were in excellent condition. In fact, comment was made by the entire force at the time as to the plumpness of the fish, both male and female.

From the experience the past two seasons, it has been fairly well demonstrated that from twenty-five to thirty artificial nests, arranged in favorable locations, would be most productive of results in an area of water equal to Pond P, or seven-tenths of an acre. It has also been decided that the previous fall the ponds should be thoroughly cleaned, and nothing left to be done the following spring except to place the nests. At the time of cleaning in the fall, the ponds should be drained perfectly dry,

if possible, so that any scattering yearlings that may have escaped the seine the previous spring may be removed. This is essential if success is to be had with the succeeding hatch, for even a few well advanced yearling fish in the pond would, the following season, destroy large numbers of fry and fingerling fish.

With reference to the guarding of the nest by the male, the observations at Northville could hardly substantiate what has been said of this feature of the small mouth bass work by others to the effect that the male guards the young bass until they are about one inch in length. The writer's experience has proved that soon after they begin to take food, from eight to ten days old, the young bass begin to distribute themselves around the edge of the pond, the adult male fish giving them practically no attention. They are fairly well scattered about the edge of the pond, if it is not too large, long before they are an inch in length. Furthermore, I see no reason why they should be guarded, and kept huddled up, as they are in quest of food, and the more they scatter, the more and better feeding grounds are to be found. It is also certain that fry transferred from the screened nests to a rearing pond, away from the care of the adults, do equally as well as those left in the pond with the parent fish. In this connection, another point to be brought out is that practically none of the young bass are eaten by the parent fish of either sex, until they are from one and one-half to two and one-half inches long.

In no paper or publication has been discovered any statement as to the exact period of incubation, in a given temperature of water, of the eggs of the small mouth black bass. It may, therefore, be of interest to cite a specific case observed at the Northville Station the season just passed, that gives this data with considerable more exactness. In order to arrive at something like a definite conclusion, an artificial nest selected at random at the beginning of operations, was marked, and carefully studied thereafter. On May 16th, between 10:00 A. M. and 3:00 P. M., eggs were spawned on this particular nest. It was examined very closely from day to day until May 21st, on which day at 11:00 A. M. there was no indication of the fish leaving the shell, but at 3:00 P. M. all were hatched, thus deter-

mining the time of incubation to be five days at an average temperature of 63 3-5°, Fahr.

With regard to the volume of water supplied to each pond, it may be anywhere from 200 down to ten gallons per minute, which latter is ample for the average pond to offset evaporation and seepage. In fact, it is much better to have a light flow, as the temperature will be higher, and it is considered that natural food will increase faster in the warmer water. Also at the spawning time it is absolutely necessary that as small a quantity as possible be used, that the temperature may be kept above the danger point on cold days of 54°.

From conditions recently noted, one can conservatively say that a pond of seven-tenths of an acre, should, with the proper proportion devoted to spawning area, produce from 75,000 to 100,000 fry on the average. This same area, with one-third to one-half that number of fry retained in the pond, should produce from 10,000 to 15,000 fingerlings, with also possibly from 1,000 to 3,000 to turn out in the fall at the final cleanup.

In order to obtain the best results at a small mouth bass breeding station, the ponds should not be too large or too deep, but have plenty of them. It is preferable that they be from one-half to not over three-quarters of an acre in area, and a maximum depth of six feet in about one-quarter of the pond is best. It is thought that by removing one-half of the fry from a spawning pond used to its full capacity, practically as good results will be obtained with the number of fingerlings turned out, as though all the fry had been left, unless at some time in the future, greater quantities of food may be grown in a limited area.

DISCUSSION.

During the reading of his paper Mr. Clark said:

I call these nests in my paper, the Lydell nest, because he invented them, and I want to give him the credit.

We have our pond so arranged that whenever there is a "roil," which of course is considered fatal to the eggs on the nest, we can, by closing one valve and opening another, change from creek to spring water. This is very desirable in a bass pond, when you have the roil; and it forms the basis of a very

interesting and easy experiment. It is said by both Mr. Bower and Mr. Lydell, to be a very good feature of the Northville plant.

Mr. North: Is your object in using the creek water and spring water in combination, to keep the water warmer?

Mr. Clark: There is no combination.

Q. You use spring water at one time and creek water at others?

A. Yes, sir.

Q. What is the object of that?

A. We prefer the creek water, but we change in case of roil in the creek water, which we want to avoid. Of course, where you have not got any spring water, the creek water can be turned off and no water run in the pond at all, so long as you can keep the water high enough.

Mr. North: In our hatchery at London we use spring water entirely.

Mr. Clark: That is not so good for the young fish, because you have not got the food there.

Mr. Whish: What water plants do you have in your pond?

A. We have several, but I like the chara moss the best. It produces the most food. Interest might be aroused in describing how I spent an hour one Sunday morning lying down to watch the young bass apparently eating the vegetation. Of course they were not, but instead were after the little insects on the vegetation. In no place did I see them attack any plants whatever except the chara moss. I watched particularly to see if they would not take hold of any other vegetation, but they kept going around naturally and I did not see them touch anything else.

Dr. Evermann: You said it was observed that the parent fish did not feed practically at all upon the young until they were an inch and a half or two inches and a half long?

A. That is my judgment.

Q. What was your observation as to feeding on the young after that age?

A. None at all.

Q. Have you observed the young fish feeding on each other at all?

A. I never saw them do it, but I have no doubt of it.

(Mr. Clark produced bottles containing specimens of small-mouthed bass.)

Mr. Clark: You will notice in the largest specimen bottle where the fish are fifty-four days old, they measure three and one-quarter inches in length; and here are others of the same age which do not exceed one inch in length. These latter are starved fish and all were taken from the same pond.

Mr. Lydell: Did you not have a later spawning with that sized fish?

Mr. Clark: Possibly, but they were all put in that pond the very same day from the very same nest.

Dr. Evermann: Fed in the same way?

A. Yes, natural food.

Q. Are the sizes typical sizes?

A. Yes.

Mr. Lydell: I understood those were left in the ponds with the old fish?

A. No, they were not.

In this connection I wish to state that I thought I had solved the problem why these fish were starved. Possibly I have, but it is not as clear as I thought it was, last Friday night when I told Mr. Ward Bower in regard to it, and that I wanted the men to be sure to catch some of the fish for me on Saturday, some of the starved fish and some of the large fish that had escaped from Pond N into that pond. All the fish in that pond seemed to be large. He said, all right, and they were there the next morning, and after dinner they went to work. The fish

culturist asked me to go with him, and I did so. I wanted the large fish out of that pond, where there are any quantities of vegetation, and this chara moss more than any other pond, and I thought that was why they were so large. We caught those and got as many specimens as I wanted, and then I told them to go across to the stunted pond and they did so, and they made two or three little hauls; and, by the way, we have a large quantity of shiners in that pond. That I thought was why these fish were starved, because their food had been destroyed by these shiners.

Mr. Lydell: Are all of your fish in that particular pond of that size?

Mr. Clark: Just a minute. No. They went across to the pond and got two or three specimens; they moved up the shore and the first thing they knew they got hold of a big one, which was quite strange. We got a few more specimens and they then went around and obtained quite a number of the large fish. That, of course, upset my theory of the large fish in Pond Q, because here were some in this other pond also of large size. But I reasoned the problem out in this way, that the most of the fish in the pond were starved at an early period; the food that they should have had was eaten by the minnows, of which there was an enormous number. A number of them, however, succeeded in getting a start sufficient to permit of their feeding on the starved bass and very little minnows.

Mr. Lydell: Last year we held some fish in our screens too long before planting, and they never recovered. They were like Mr. Clark's fish, they were starved. I did not know but perhaps you had held your fish in your screen too long before transferring them to the rearing pond.

Mr. Clark: Here are some from other ponds transferred at the same time (showing specimens), and they are of good size. There was nothing of that kind. These fish were moved from the screens at the proper time.

Mr. Lydell: In shipping this year from Mill Creek our fish varied a great deal in size, but not as much as that.

Dr. Evermann: Was any examination made of the stomach contents of the big fish?

Mr. Clark: That is being done now, to see whether they have young bass in them. For fear you might think that some of these larger fish were small yearlings, I have brought along another specimen which is a small yearling, to show the difference.

(Specimen exhibited.)

Mr. Lydell: There is one part of your paper where you speak of your fish spawning in deep water, that is very interesting. I had some fish spawn in four feet of water, and the old bass stayed there and took care of those fry. They were scattered along the shore, a distance of probably thirty or forty feet, and the old bass patrolled his beat with great regularity. Although at Mill Creek we took a screen and put it over our nests, over half of those were still watched by the old fish swimming around outside of the screen.

Mr. Clark: Don't misunderstand what I say here. I do not mean that the male bass does not guard them, for he certainly does, but not until they are an inch long.

Mr. Lydell: I never saw him do that except where I made my earlier observations, there I have seen them guarding young bass when they were an inch and a quarter long. They would be scattered a long distance up the shore, but you could see the old bass would swim the length of the school and back and forth; so it was very positive that he was guarding that lot of fish. But I have not seen that in our ponds. In the absence of enemies probably he thinks it is not necessary.

Dr. Greene: Mr. North and I have been talking about this matter to-day. The superintendent of our farm at London has been using the apparatus devised by Mr. Lydell. They used it two seasons and used it this year; and in conjunction with that he has gotten up a device of his own. He goes along the bank, puts down gravel for a bed, then he also drives a stick down there in which he puts in partitions with slots, that he can slide partitions in; and if the bass use that bed and the eggs are laid

there; he then stalls that off; and we are trying that this year in connection with Mr. Lydell's apparatus. Mr. North and I have decided to have our superintendent keep a careful record of his work this year; and next year we want him to address the Society as to the comparative value of these two methods. We have at London, I think, the best springs and best ponds that I have seen or heard of anywhere. We have, within a distance of a quarter of a mile, a thirty-foot fall. That is one thing that is very desirable. Our waters, unfortunately for bass culture, is very cold spring water. The ponds are in tiers, starting from the west, and placed crosswise, parallel with the stream that formerly carried this water; and we cannot use the first pond or two on account of the cold water. We have no streams in the state where trout can be planted to advantage; but our third, fourth, fifth, sixth, seventh and eighth ponds, on down, where the water is warm, are very desirable for bass.

I have not had much experience, but have heard the superintendent talk about the question of the male guarding the spawn. He insists that they do that. He does not believe in cleaning his ponds too closely at the edge, but leaves all the vegetation and moss, because he regards them of advantage for the safety of the young fish. As soon as they take care of themselves they get into this moss and are free from their enemies, and protected there.

Mr. Clark: That examination of the specimens has just been completed. No bass or other fish were found in them. The specimens were taken out in the pond and immediately placed in formaline without being held any length of time. I still think, however, that the theory I expressed to the effect that they may have been feeding on the starved bass, or very small shiners, may be correct.

Mr. Meehan: In regard to the cannibalistic tendencies of young small mouth bass, I would say that last year, about the first of July, we placed 20,000 small mouth bass, probably an inch long, in a small pond. They were fed with ground fish, six times a day, and on the average it is estimated that they ate about three times their own weight of that food. On the first

of October we took the fish out and counted them, and there were 11,200.

Mr. Clark: In this connection I would like to state more fully and forcibly my idea on the rearing, or partial rearing of the bass. I think that a pond somewhere from three-quarters of an acre, to an acre in size, is better perhaps than a larger one, and can be handled easier; if you are going into bass operations on a large scale you should have a great many of these small ponds. The work of caring for them does not amount to anything. You have no food to prepare; no time is required in feeding; and one man will take care of 200 ponds just about as easily as five or ten. All he has to do is to screen them, and the feeding operation is going on all the time. Of course, with your artificial food you may be able to get out a better percentage, but we are looking for quantity as well as quality. I have been feeding fish for many years, but I am not prepared to say that the artificial food fish is as good as a natural food fish. Get back to nature, that is my plan; let them feed themselves and all the time. At Northville, instead of having the six ponds we have, there should be sixty, if we are going to do a great work.

Mr. Lydell: I had arranged this spring to carry on experiments in regard to feeding young bass, but unfortunately just as I had my ponds stocked and the fry ready to be introduced into these small ponds, we had a flood there that put us out of business, practically, as far as the small mouth bass were concerned. We only used two ponds there for breeding them this year, and from those two I had 58,000 that I had to ship as fry, because I did not have rearing pond room for them, although we used all our ponds for that purpose except one for large mouth bass.

In one of our ponds the chara weed was driven out by some other notorious brute of a weed that I do not know the name of, and there was no food there for the young bass. They did not seem to collect on the substitute weed as it did on the chara. I went around the shores of this pond and cleaned down probably five or six inches of dirt and spread white sand on that, and in a few weeks the chara came up through the sand and the other

weed disappeared. The nests that Mr. Clark spoke of in the beginning of his paper I lay no claim to whatever. In my article read at Put-in-Bay, you will find that I say something about the nests being used by Mr. Stranahan, and I give him credit for getting up that nest at that time. Although the idea was original with me, I found afterwards that he had used the nest long before I conceived the idea. So that I lay no claim to its invention.

I have some specimens of fish here to which I would like to call Mr. Clark's attention and ask him to compare them in age and size with his specimens, to classify them, and to state how many he would ship per can. They are mostly large mouth bass.

Mr. Clark: I do not think that the question of the numbers in the can has been brought up here.

Mr. Lydell: No, it has not, and this committee that we had appointed a few years ago has not decided yet what we shall call these fish.

Mr. Clark: The committee themselves do not seem to be decided.

Mr. Lydell: I am still shipping mine as fry, as baby-fingerlings and fingerlings, advanced fry, and yearlings, and two-year-olds, and several other sizes.

Mr. Atkins: I am still taking the pains to say just how many days old our fry are from the egg. I put that down in my report. I have not learned yet what the name fingerling means, so I never dared to use it.

Mr. Lydell: I find you cannot go according to ages for the the reason that we have, for instance, fish two months old varying in length from half an inch to two inches.

Mr. Seymour Bower: In regard to the standard of size, I could not agree with Mr. Clark's suggestion, calling them No. 1, up to thirty days, etc., but I like the idea of classifying them by number. But I would rate them according to length, 1 inch, No. 1; 2 inch, No. 2; 3 inch, No. 3, etc.

Mr. Clark: What would you call an inch and a half?

Mr. Bower: I would call them No. 1. Above an inch and a half or perhaps two inches I would call No. 2. You will come a good deal closer to understand what is meant if you classify them according to length rather than according to age. As you have shown, starved fish may be only one-tenth the size of others of exactly the same age; but in classifying them by length you cannot be more than half an inch out of the way, either way. That is my idea of the proper method to grade the fish, so we may know very closely what is meant every time, whereas you cannot if you grade them according to age.

Mr. Clark: As to the shipments per can, about which Mr. Lydell asked, he ships large mouth bass an inch long twenty days old, a thousand per can. This is about the same number we ship of the small mouth, except in cases of abnormal growth.

President: I think Mr. Titcomb made the suggestion that they did not care much at the Fish Bureau what designation was given fish; they sent out what they had. Will you please state your mode of classification at the bureau?

Mr. Titcomb: At the present time we have a plan of distribution showing fry, fingerlings and yearlings. Of course that is very broad. Fry are the young fish until they have been fed for a time and are perhaps an inch or an inch and a half long. Then they begin to be fingerlings, and continue to be fingerlings until they are perhaps three inches long, which depends on the kind of fish; and then in the fall of the year, as they get larger, they are called yearlings. Mr. Bower suggests numbering, as I suggested, only he has reference to the length of the fish, while I have reference to the age of the fish, and he has reference to one species of fish, while we want the committee to select it for all species. If we could, in our fish cultural parlance, not only designate them as No. 1 for one month old, but in connection with that give the size or weight per thousand, we would know what we are talking about. But for general tabular distribution, it seems to me that the numbering according to age would be suitable. In all this work I think we want to get into our tables and into our papers, not only a description

of the fish at a certain season of the year, or of a certain age, but the weight or some designation equivalent to that. Local conditions vary so at the different hatcheries of the country that fish of the same age may be an inch long in Maine, and three inches in Texas, respectively. Whatever kind of fish we are talking about, and when we are discussing questions of food and growth, I think we want to give all possible data, but in giving the tables to the public, it seems to me the general plan we have adopted in the bureau now, is as good as any, to call them fry, fingerlings, and yearlings. As far as the public are concerned they are satisfied.

Secretary: Do you mean to say that a bass the same age would be three inches long in Texas, and one inch in the north?

Mr. Titcomb: Yes, just about—not always, of course. There is a great variation of growth there, just as there is with us here, only it is much more marked.

Mr. North: Would it not be advisable to get up a combination name to indicate both age and length; for instance, No. 1 A thirty days old. No. 1 B sixty days old, and have the figure designate the length, and the letter the age. For instance, a fish an inch long and sixty days old may be No. 1 B.

DISCUSSION ON MR. TITCOMB'S REPORT ON POND CULTURE.

Mr. Clark: I have not anything in particular to say regarding Mr. Titcomb's paper on "Pond Culture," but I do think, now that we are working into the bass culture problem, that there ought to be more papers along similar lines; more especially in reference to the vegetation and on the question of growing natural food. I hope something will be brought out more particularly next year, perhaps not as much on how long a bass will grow, etc.; but we do want to know how, when, and what to put in our ponds to grow the proper vegetation and make the proper quantity of necessary natural food.

Dr. Evermann: I am rather inclined to believe that some of the difficulty is due to confusion of species. I have observed in aquariums, for instance, that *Myriophyllum, Cerratophyllum,* and a species of *Bidens* are often mistaken one for another.

The horsetail *Ceratophyllum* is objectionable because it is a floating plant and is not so desirable as the *Myriophyllum,* or the *Bidens beckii.* There are many species of the so-called water weed, and they differ a great deal in their values as forming a nidus for the growth of aquatic food, the different species of crustacea and various species of protozoa.

I would like to know upon just what is based the statement that the different species of chara are particularly valuable. At first blush it would seem that chara might not be so valuable a plant as a food producer as some of these other plants. It is coriaceous, lime-coated and hard; and is not a plant that would furnish food on which the young fish might feed in so large a degree as other plants.

Some little time ago some investigations were made by the Bureau of Fisheries at a certain lake in northern Indiana (Lake Maxinkuckee), and certain relations were discovered or thought to be discovered between the presence of young bass, large mouth and small mouth, and certain species of aquatic plants. The lake was two and three-quarters or three miles long and

one and a half or one and three-quarters wide, and quite regular in outline; and seining was carried on around that lake periodically for four months in the shallow water of the entire shore. It was seined with a fine-mesh Baird collecting seine during the first week of each month for four months, and the character of the vegetation over which the seine was hauled each time, was noted. The depth of the water, the temperature of the water, and different species of fishes, crawfishes and other animals that were caught, were examined; and the number of individuals of each kind, and the approximate sizes of the individuals of each kind, were determined; and particular attention was paid to the young of the large mouth and the small mouth, the rock bass, and the bluegill, for four species of food fishes found in that lake; and my recollection is that where the chara covered reaches of the shore, our efforts did not result in capture of as many small mouth bass as did those portions of the shore where we found Potamogeton, and certain other species of plants. Indeed, the Chara-covered part was regarded by those who carried on the work, as the barren portion of the lake. We would find there certain species of darters in considerable numbers, but neither the large mouth nor small mouth bass was found there in considerable numbers.

Now as to what species of plants are oxygenating and what are food-producing, I doubt if you could make any classification that would be of very much value on that basis. All aquatic chlorophyll-bearing plants are the same, except in degree, and as to what the plant will do in those regards depends on the time of the day and many other factors.

Mr. Titcomb: There was no confusion as to the different plants, so far as we went through them. They were all identified by the chief of the Bureau of Plant Industry, Mr. Covil and his assistants, before we made up our minds as to what we liked and what we did not, what had good features and what bad.

I will give you a list of what we considered the best at the fish ponds in Washington:

1. Ceratophyllum demersum.
2. Cambomba Caroliniana.
3. Vallisneria spiralis.

4. Potomogeton crispus.
5. Potomogeton foliosus.
6. Philotria canadensis.

But some of the sub-species are more valuable than others, and in talking the matter over with the plant physiologist it was agreed that it was not at all impossible to ascertain the comparative oxygenetic powers of the various aquatic plants. Perhaps it would be necessary to take a young man out of college as a scientific assistant or something of that sort, and let him work at it a year or possibly two, but it would be a valuable contribution to literature and to all those interested in these questions. We are going it blind. We have a lot of objectionable plants in our ponds. They are just as objectionable as the pig weed in our gardens. We want to know what they are; we do not want to introduce them where we start anew, or introduce them in the ponds of the anglers where they want food plants. All those questions are constantly coming up in the Bureau of Fisheries; and I might say that there are gentlemen here now who would like to know what to put in ponds full of stunted, starved bass.

Dr. Evermann: You have no species of chara in that list?

A. No.

Mr. Clark: I want to put in an emphatic protest against the criticism of the chara plant, for if it does not furnish food I do not know what our bass are feeding upon. We get excellent results where there is not a particle of vegetation in the pond excepting chara.

Mr. Meehan: This chara plant grows in bunches, does it not?

Mr. Clark: It forms one solid mass. We had some that was taken out this spring, and find that it decomposes to lime; that is, it is a lime plant. And the fresh water shrimp that the doctor discovered came off that chara plant. The smaller bass keep nipping, nipping on chara plant, and in this pond that I have mentioned there was other vegetation, yet they touched nothing else.

Mr. Lydell: I want to endorse Mr. Clark's remarks regard-

ing chara. I was out for the Fish Commission a couple of years and we got a great abundance of this plant, chara. And if that plant does not produce food I don't know what does. In one of our ponds this year where there was nothing but chara, you could see great clouds of food over this plant. You could take a pan and dip it up and could not see the bottom of the pan. What this food was I don't know. It is a new food that came there last year. I sent some to Ann Arbor to be identified, but never received a report.

Dr. Evermann: Have you made any comparison as to the value of different plants?

Mr. Lydell: Yes, sir. I found that Potomogeton drove chara out, and I could not raise 100 fish where before the chara went I could raise 1,000. I would like to find out what this new food is. It comes when the young fish are coming off the bed. When you look down on it you see a little three cornered black speck. Along the shores of the pond were thousands of little black shells about one-eighth of an inch in diameter, from which apparently these animals were hatched.

Mr. Seymour Bower: Two years ago this summer our board of Fish Commissioners engaged the services of Professor Reighard, the well-known zoologist. He was employed at the Mill Creek Station for three months to solve some problems in connection with bass culture. I have copies of his report with me and will be glad to give one to any who may desire it. My recollection is, his conclusion was that the chara was the best food producer of anything in the ponds.

Mr. Lydell: Professor Reighard said he never saw a pond so teeming with bug-life as ours with the chara in it.

Mr. Clark: Is it not probable that the vegetation which produces the animal food for our ponds at Northville, if transferred to other waters, say in Washington, Georgia, etc., might not do?

Dr. Evermann: I think so, decidedly.

Mr. Clark: The water and other conditions may produce this food at Northville, whereas the chara might be barren at

other points. We have got the plant that produces the food; we grow the bass with this vegetation, and until something is furnished which is better, it seems as though it is the plant we want to use.

Mr. Lydell: If there is any aquatic plant which we can substitute for the chara, and which has superior food producing qualities, we want it, but we would like to grow 5 or 6 or possibly 100 fish to every foot of water. So if you have any old weed that will produce the food, produce the weed. (Laughter.) If we have been working in the dark and produced thousands where we could produce millions of fish, we should like to be convinced of our mistake.

Dr. Evermann: The characters of the different species of chara depend on the ground. I have seen some places where there is very little lime in the soil or water, where none of the species of chara would do well. In this lake that I have in mind there is a wide belt of marl beginning out at a depth of perhaps 2½ or 3 feet and extending on into the water 8 or 10 feet in depth. Well, on the outer half of the strip of marl, and further on to the shore, various species of chara grow in abundance, but in some other parts of the lake they do not. When, however, we came to the end of one of these chara patches, where there is a certain species of Potomogeton with the broader leaves, not the fine-leaved *Pectinatus,* we found the young bass; but we did not find them under the fine-leaved *Pectinatus* at all.

YELLOWSTONE PARK AS A NATIONAL FISHING RESORT.

(Illustrated by Lantern Slides.)

BY A. H. DINSMORE.

An outline of the lecture is as follows:

In 1872 Congress passed a bill setting apart a great volcanic plateau locked away in the heart of the Rocky Mountains, and comprising an area of more than 3,500 square miles, as a "public park and pleasure ground for benefit and enjoyment of the people." Because the greater part of its surface is drained by the Yellowstone River, this reservation has been called The Yellowstone National Park.

Yellowstone Park is most widely known as a region of strange natural phenomena and beautiful mountain and canyon scenery. It was for the preservation of these features alone that Congress was induced to exempt this vast region from settlement. But public measures, good or bad, seldom fail to reach in their ultimate results far beyond the conception of the assemblies which pass them. And so Yellowstone Park has become famous for many things of which its most enthusiatic advocate never dreamed. Thus, as the nucleus of a great timber reserve, its magnificent forests protect the sources of three of the most important rivers of the North American Continent, —the Missouri, the Columbia, and the Colorado of the west. This one feature, as a safeguard from flood and a potent factor in the great problem of irrigation, is alone worth to the American people many times the cost of its maintenance.

Then, as a great natural game reserve it is of inestimable worth for its preservation of the wild life of the west. Here all the animals indigenous to the Rocky Mountain region find an asylum where, unmolested by the hand of man, they may roam at will. And though elsewhere many species have already become rare or ceased entirely to exist, in the Park they are as abundant as ever and so tame as to be continually under the observation of the tourist.

All these features have been written about and talked about till they should be matters of general knowledge. Of one feature, however, of greatest interest to us as fish-culturists and fishermen, little is known, for little notice has been taken of the trout which now abound in its splendid lakes and streams.

But there is, perhaps, a reason for this ignorance in the fact that only a few years ago all its waters, except those of the Yellowstone basin, were entirely destitute of fish life of any value. The absence of trout from these streams and lakes has been accounted for on the assumption that all animal life was destroyed by the flow of volcanic matter which formed the plateau, while fish have been unable to ascend the streams from below on account of the great natural obstructions which they contain. But if these theories are accepted it becomes necessary to explain their presence in the Yellowstone, whose mighty cataract exceeds by far the falls of any other stream.

Scientists, some years ago, advanced the theory, which other writers have followed, that black-spotted trout, with which the entire Yellowstone system abounds, came here from the Pacific slope through Two Ocean Creek, a remarkable stream which, sub-dividing, sends part of its waters to the Atlantic and part to the Pacific. No account seems to be taken of the fact established by the geological survey, that Yellowstone Lake once stood 150 feet above its present level and then vented its waters to the Pacific through Outlet Creek and Hart River. As there were then no obstructions between the Yellowstone and the natural trout waters below, why may trout not have come here while this system of waters was still a part of the Pacific coast drainage?

However this may be, the fact remains that the Yellowstone had trout in great abundance when the region was first discovered, while they were entirely absent from all its other waters. The idea of creating from these barren lakes and streams a Great Natural Fishing Resort seems to have originated in 1889 with Capt. A. F. Boutelle, the then acting superintendent.

No stronger commentary on the success and value of fish-cultural work exists than that found in several pithy paragraphs from various reports of Capt. Boutelle and some of his successors. In his first report for 1889, Capt. Boutelle calls attention

to the original condition of things by saying: "I notice with surprise * * * * * the barrenness of most of the waters of the Park. Beside the beautiful Shoshone and other smaller lakes there are hundreds of miles of as fine streams as any in existence without a fish of any kind." He at once brought the matter to the attention of Col. Marshal McDonald, then the U. S. Commissioner of Fish and Fisheries. Through his efforts 7,000 young fish were planted that year and 150,000 the year following. The work was remarkably successful from the first. For we read from the report of his successor, Capt. Anderson, only four years later: "During the season fish are taken in all the lakes and rivers in numbers almost passing belief. All streams heretofore stocked with trout now offered excellent fishing, probably no better exists anywhere."

Frequent reference in late reports of Major Pitcher, the present acting superintendent, to the fine fishing in these lakes and streams is sufficient proof of the lasting results of this work.

In stocking these waters, it has been the plan to place but one species in each river basin. Thus to the Gardiner and its tributaries has come the brook trout from the east. The Gibbon has received the rainbow from the Pacific coast, and the Firehole the Lochleven from Scotland. Below the junction of these last named rivers, in the Madison, both species mingle with the black-spotted trout, the Montana grayling and a native white fish. Other waters on the west side of the divide have been stocked with the lake trout and land-locked salmon, while the native black-spotted trout has been left practically undisturbed in their natural habitat, the Yellowstone.

The importance and value of this work will be understood if we remember that fully fifty miles of Park roadway, over which more than 10,000 tourists pass each year, lies along the course of these streams or skirts the lakes. But its greatest value is in its permanency. When other streams throughout the country become unsuited for trout life, as many already are, the beautiful lakes and streams of Yellowstone Park preserved in their primeval purity will carry to future generations a knowledge of these lords of the finny tribes.

Then, too, the region may in the future be the source from which shall come, from territory entirely under Government

control, many of the eggs of the various species of trout needed by the hatcheries scattered throughout the country. For several years past Yellowstone Lake has been utilized for the successful collection of black-spotted trout eggs. But with proper direction and oversight it should be an easy matter to extend the work to other species.

All other features of this great public park are being jealously guarded and fostered. Soldiers patrol its roadways, protecting its game from poachers; its formations from vandals, and its forests from the fires of the careless campers. Civilian scouts perform the same duties in the outlying districts. Its fish alone are left mainly to shift for themselves.

Here is a region belonging in a peculiar sense to all the people in which are trout waters of greater extent and value than those of many of the states, and yet its fishing interests are left entirely without skilled oversight. It has always seemed to the writer since he became familiar with these facts, that the National Bureau of Fisheries should have a representative in the Park that these interests may receive the same intelligent oversight and direction given such interests in the various states or the other interests of the Park. This seems the more important since its administration is in the hands of army officers, men of the highest ability and integrity but subject to frequent change, and in the very nature of things possessing no knowledge of fish-cultural matters. Hence there is constant danger that wrong plants may be made and the plan of keeping the various species separate ruined beyond remedy.

Under the directions of a superintendent of fisheries the fishing in many waters may be improved, fish may be planted in other waters still barren and the Park made in all truth the Great National Fishing Resort.

THE INTERNATIONAL CONGRESS OF FISHERIES AT VIENNA, 1905.

BY HUGH M. SMITH.

The Third International Fishery Congress convened at Vienna in June, 1905, under the patronage of the Austrian Fishery Society—a large, flourishing, and influential body which celebrated its twenty-fifth anniversary during the meeting of the congress.

The plan for holding international fishery congresses at regular intervals originated at Paris during the exposition of 1900, when the first congress was held. The second congress met at St. Petersburg two years ago. I had the privilege of attending both the Paris and Vienna congresses as the representative of the United States Government.

The president of the Vienna congress was Prof. Dr. Franz Steindachner, of Vienna, one of the foremost ichthyologists and the director of the admirable natural history museum of that city. The attendance was large, nearly 400 delegates being present; and the foremost fishery and fish-cultural authorities and workers in Europe were present. About twenty countries were represented, although there were some conspicuous absentees. Most of the European countries had official delegates, although the governments of such important fishing powers as Great Britain, France, and Norway had no representatives. From the far-distant British colonies of Australia and India special delegates were sent. The great western hemisphere made a poor showing; besides the United States, the only countries represented were our progressive sister republics, Argentina and Chili.

It is not necessary to refer in detail to the proceedings of the congress. Suffice it to say that the papers and discussions covered a very wide range of subjects; and it was the general opinion that the meeting was more successful and important than either of its predecessors.

Armed with authority from the Commissioner of Fisheries

and the Secretary of Commerce and Labor, I extended to the congress an invitation, on behalf of the United States Government, to hold its next meeting in the United States. The matter was first considered by the permanent committee on international congresses, of which I am a member, and was then referred to the full congress for final action. It was very gratifying to me that the congress voted unanimously to accept our invitation, out of sincere regard for and interest in the country which is foremost in fish culture and economic fishing. The time for the meeting was fixed for the latter part of September, 1908, and the place selected was very appropriately Washington, D. C.

At the proper time, I shall ask this society to take action with a view to its co-operation with the local committee of arrangements. I do not want the Society to commit itself too far in advance, but it seems to me that it will not only be proper but decidedly advantageous for the Society to meet in conjunction with the international congress—perhaps a day or two before—and I trust you will regard favorably the suggestion that you determine informally to hold your 1908 meeting in Washington.

It is incumbent on the United States to make the international meeting a great success; the reputation of our country is at stake. No people can contribute so much to secure the desired end as the members of this Society, individually and as a body; and I bespeak for this important project your cordial support.

THE STATUS OF THE CARP IN AMERICA.

BY LEON J. COLE.

(Read by Dr. Evermann.)

(Presented by permission of Hon. George M. Bowers, U. S. Commissioner of Fisheries.)

It is impossible to present in a paper of a length suitable to these meetings even a tolerably complete review of the carp question in this country. But since this is a topic of discussion which has not infrequently come up at previous meetings, and is one on which divers opinions have been expressed by members of the Society, a brief resume of the principal conclusions reached during an investigation of the subject by the writer, extending over a period of three or four years, may not be without interest. Manifestly very little of the data upon which these conclusions rest can be given, but it is expected that there will soon be published a full report on the work, which was undertaken by direction of the U. S. Bureau of Fisheries. The investigations were made principally on Lake Erie and Lake St. Clair and were prosecuted, for the most part, during the summer months of 1901, 1902 and 1903.

The first introduction of carp into America is a matter of more or less uncertainty. Although the name appears occasionally in earlier writings, apparently referring to some species of native fish, the first record bearing any stamp of authenticity is one by which Henry Robinson, Esq., of Newburgh, Orange County, New York, is credited with introducing these fish into the Hudson River in about 1831 or 1832. It has since been contended that the fish brought over by Mr. Robinson were not true carp; but in 1872 undoubted scale carp were successfully acclimatized by Mr. J. A. Poppe in Sonoma County, California, where they thrived well and multiplied with great rapidity. The first importation by the U. S. Fish Commission was made in the spring of 1877, and was followed by two or three other lots in succeeding years. Ponds were constructed for these fish in

Washington and Baltimore, and it is their progeny which were distributed and have populated nearly all of the available waters of the United States.

At first the carp met with great popular favor and requests for young fish came to the Fish Commission from all parts of the country far faster than they could be filled. Largely on account of ignorance of the proper methods, or negligence and want of proper care, pond culture did not, however, meet in most cases with success; and not only was almost all attempt at artificially raising the fish soon abandoned, but they came into general disfavor almost as rapidly. This was probably due to a variety of causes. In the first place the quality of the flesh did not compare favorably with many species of native fish, and in this respect did not fulfill expectations. To make carp palatable it is usually cooked in ways that were more or less unfamiliar or unknown to those who were trying the experiment in this country, and for this reason, too, it was not appreciated even for its true worth. But the adverse criticism became even stronger and more widely spread as, coincident with the rapid decrease which was noticed to be taking place in the numbers of many of our native fishes, the carp as rapidly multiplied and came to be exceedingly abundant in all the waters adapted to them. Not only were they held to be responsible for the decrease of other fisheries, but, owing to their propensity to stir up the mud and to root out aquatic plants, they were charged with destroying the vegetation in the marshes, and thus, secondarily, were said to be the cause of the rapid decline in the numbers of wild ducks and similar birds, whose feeding-grounds, it was claimed, were thus destroyed. The constant roiliness of the water, especially in reservoirs, due to the presence and operations of the carp, in many cases became a positive nuisance. But since nearly everyone is familiar with the strong dislike with which the carp has come to be regarded in all but perhaps two or three sections of this country, it is unnecessary to go further into detail. The investigations here reported were undertaken with the view to ascertain, in so far as was possible in a limited time, the true state of affairs—to find to what extent the carp was responsible for the changes taking place; and, on the other hand, to determine

its value as a food fish, and whether in this respect it was being utilized to the fullest possible extent.

I have elsewhere summed up the principal charges against the carp as follows: (1) that the carp thrashes about and stirs up the mud, so that the breeding-grounds of other fishes are spoiled; (2) that the carp roots up the vegetation, destroying the wild rice, etc., thus ruining good duck-shooting grounds; (3) that the carp eats the spawn of other fishes; (4) that the carp eats the young of other fishes; (5) that the carp is of no value as a food-fish; (6) that the carp is of no value as a game fish. To the first of the above charges should be added as a corollary that the stirring up of the mud of supply reservoirs often makes the water unfit for use.

In studying the relation of carp to other fishes special attention was paid to the small-mouthed black bass, which breeds abundantly in Lake St. Clair, and to the whitefish in Lake Erie. The former species builds its nests in numbers on the shoal, sandy bottoms at the St. Clair Flats, and as the carp is plentiful in the same localities, this seemed a favorable opportunity to make observations on the two species together. One breeding-ground in particular was watchd continuously. But although the carp frequented and fed among the rushes of the shallow water near shore, they were never seen on the actual area occupied by the bass, and it could not be learned that they interfered with the bass in any manner whatever. Examination was also made of intestinal contents of carp taken in the same neighborhood, but in no case were the eggs of any kind of fish found among the material thus obtained. The principal food at this place was found to consist of certain aquatic plants, especially the stonewort (*chara*), and the larvæ of insects—mainly that of the May Fly, or "June Bug," as it is often popularly called.

At the western end of Lake Erie, where the whitefish come in the fall to spawn upon the reefs, especially in the neighborhood of Kelley's and the Bass Islands, there had been much complaint among the fishermen that the carp were also on the reefs in great numbers, and that at such times they destroyed large quantities of the whitefish spawn. In the fall of 1901 attention was turned to this phase of the question, and from Port Clinton, as a base, trips were made with the fishermen to the

fishing-grounds. In addition many carp which had been taken in the pound-nets with whitefish were examined at Port Clinton. The results of these investigations showed that comparatively few carp were on the spawning-grounds at this season of the year, while all that were taken were small fish, seldom exceeding two or three pounds in weight. Examinations were made of the stomach contents of carp taken in gill-nets directly on the reefs, and only in two cases was anything found that could be identified as eggs of the whitefish. Moreover, the water is cold at this season of the year, and under such conditions carp are usually inactive. It thus appears that although they do undoubtedly destroy some spawn the total damage done to the whitefish by the carp is probably small. It is rather generally conceded, too, that the supply of whitefish is being in large part maintained by the work of United States and state hatcheries, by which means the spawn is being removed from the danger of being devoured until the young fry have hatched.

There is little evidence to support the conclusion that carp eat the young of other fish. It has been known to happen on one or two occasions when the fish were confined in aquaria, but probably is not frequent under natural conditions. The carp, with its sucking mouth, devoid of teeth, is not adapted to predatory habits.

The charge that carp uproot and destroy much aquatic vegetation, and cause the waters in which they live to be in an almost constant state of roiliness, appears to rest upon a better foundation. But it is doubtful if the effect of this condition upon other fisheries and the wild fowl is quite as serious as has sometimes been supposed. One great objection is, however, that beautiful bodies of water are sometimes disfigured, and as has been said, the fish may cause great annoyance in the reservoirs used for storage of drinking water.

The other side of the question can best be examined under two heads: (1) The present commercial value of the carp and how its usefulness may be extended; and (2) what we may call the incidental value of the fish. The two great sources of carp for the eastern markets are the Illinois River and the suitable portions of the Great Lakes, namely, Lake Erie, Lake St. Clair, and the adjoining marshes. It was estimated by Townsend that

in 1899 the catch of carp in Lake Erie amounted to 3,633,697 pounds, worth $51,456. In 1900, as nearly as I could determine, the catch was 4,598,090 pounds, with a valuation of $68,971.35, wholesale. Indications are that in the succeeding years it was even greater, while the fisheries of the Illinois River appear to exceed considerably those of the Great Lakes. This is enough to give an idea of the extent to which carp are now being used. Some attempt has been made at smoking the larger fish, and other methods have also been used to preserve them, but those products appear never to have gained any considerable demand. The smoked fish, nevertheless, compares favorably with many other kinds now used for that purpose, and it would seem that persistence in this line should finally meet with success.

As illustrating the ways in which the carp may be said to be of use more or less incidentally, it may be noted that in Izaak Walton's time it was considered to be worthy of the angler's attention, and that even now in this country its capture furnishes amusement as well as acceptable food to many, especially those of the poorer classes. Furthermore, it is probably of value for its destruction of mosquito and other aquatic larvæ, and it has recently been shown to be an important factor in some sections of the country in keeping in check the parasite known as the liver fluke, which attacks sheep, often killing them in large numbers. Certain of the stages of this parasite are passed in the pond snail, which is eaten by the carp. It has also been found that the young carp, which can easily be raised in large quantities, make very good food for trout and bass.

The carp has sometimes been spoken of as "the poor man's fish," and such is essentially the position it would appear to be destined to occupy in the economy of our country. Those who are able to obtain better fish will undoubtedly continue to prefer them. But for feeding the great communities of foreigners and newly-made citizens in our large cities, any source of cheap wholesome food is of much importance, and, as has been shown, the use of carp for this purpose is increasing with each year. One often hears it stated that a bounty should be put upon these fish in order to attempt their extermination, or at least to keep them in check. It must be recognized that it is sheer nonsense to think of their extermination by any such means, and the

most effectual factor in holding them in check is the catching of them to supply a commercial demand. If, then, anything should be done, it should be to make the food value of the fish more widely known, and thus increase the market. At present there is no need to plan protection for the carp. They seem well able to care for themselves. But even now it is found profitable to capture them when they are plentiful in the spring, and to hold them over in retention ponds of one kind or another until the market prices are higher in the fall.

Finally, it may be said in conclusion, that whereas the carp undoubtedly does considerable damage in one way or another, it nevertheless is a valuable resource to the country, its value in this respect far outweighing the damage done. The whole situation may be summed up in the statement that the carp is here and we could not rid our waters of it, even were such a course desirable; therefore we should turn our efforts to utilizing the fish in all ways possible.

DISCUSSION.

Before reading the paper Dr. Evermann said:

I will say as a word of preface, that this paper which Mr. Leon J. Cole, of Cambridge, Massachusetts, presents, on "The Status of Carp in America," is a brief abstract of a much larger report which he made to the Commissioner of Fish and Fisheries, covering certain investigations which he carried on for a number of years.

CARP, AS SEEN BY A FRIEND.

BY DR. S. P. BARTLETT, OF QUINCY, ILLINOIS.

(Read by Dr. Smith.)

This point of view being so rare as to be almost unique, it may be wise, perhaps, to give some of my reasons for holding it, in order to free myself from possible suspicions as to my complete sanity on the subject.

As I understand it, the work of the fish commissions was designed to produce the greatest amount of benefit to the greatest number of people, the question of increasing the supply of food entering into it to as great a degree as the financial interests involved. The work necessarily has to cover localities of various and contrasted conditions, and in fitting it to such conditions it naturally follows that no one locality can be taken as a criterion as to the results which may follow the same methods in another locality or state. It is my purpose to endeavor to show that the introduction of the carp into the waters of Illinois by the United States Fish Commission, was a wise proceeding, and one that will do more toward causing these waters to produce their full quota of food than any other plan ever worked for the interests of this locality. I am aware that the waters of all the states are not so well adapted as natural homes for the carp as are those of Illinois; perhaps a brief explanation of the reasons for this may be in order. I have watched this branch of the work carefully, and while I may be a trifle more enthusiastic than many of my fellow workers, it is possible that my knowledge of conditions and results justifies my position.

I have been here a long time and my intimate acquaintance with the waters of Illinois has given me a better knowledge of the facts than that of the average man, at least, and I have seen the depletion of the fishes indigenous to those waters continue year after year, through wanton waste and lack of protection, until the fish industry, once great in its proportions, had dwindled to such a degree that the wholesale fish dealers were practically "down and out."

Owing to the peculiar conditions governing them, the waters of Illinois have been great breeding places for the coarse fishes. Thousands of acres of the low grounds are inundated every year along our great rivers, at the season when the buffalo, the greatest commercial fish of the state, are "rolling" or spawning. At this time great quantities of buffalo were easily taken, and they were shipped in large lots to the greater markets, principally to St. Louis, on commission, to the wholesale dealers, and the markets were frequently so glutted with fish that sales were almost impossible, and the freight was hardly realized. During the "sixties" the Mississippi river had two lines of steamboats running daily between St. Louis and St. Paul, and the Illinois river had as many, running between St. Louis and Peoria, and at every landing sugar hogsheads packed with buffalo were offered for shipment to St. Louis. At the wharf here at Quincy, I have seen so many hogsheads of fish offered for shipment that only a small part could be taken, as the boat was carrying shipments from all points above, and could take only part offered at each landing. At this time the boats offered almost the only facilities for the transportation of freight between river towns, and enormous quantities of freight drawn from the country back of the rivers naturally accumulated at these towns, and nearly always more freight was offered than could be taken, and although preference was given to perishable articles, still the fish were brought in such quantities that it was impossible to handle them all, and a great waste resulted. This was at a time when there were no protective laws, and it was possible to take fish anywhere and in any way. It needs but a moment's consideration to see what this wholesale waste would lead to. The supply could not long sustain it, and the inevitable result must and did follow, the practical depletion of the waters. Well, to be brief, the buffalo practically disappeared, and the large concerns engaged in fishing as an industry gradually dropped out, until only an occasional small concern was left, depending on local trade for maintenance. Later, protective laws were enacted, but were little observed, the fishermen resenting any interference with what they considered their natural, vested rights, and only by the education of the people generally to the necessity of a proper

protection could any progress be hoped for toward a proper enforcement of the laws. The buffalo increased slowly, if at all, and instead of the former great runs in early spring, there was no perceptible increase. Then the carp was introduced. Literature on the subject showed it up as a great fish, immensely prolific and of rapid growth, all that was required was a mud hole and a dozen carp to insure a year's supply of fish. The farming community went wild over them, and in a single year 3,000 ponds were constructed or arranged for the raising of fish in Illinois. I remember well the first carp Illinois procured. We were allotted a few hundreds and they were taken to St. Louis, and by some mistake, were put, with the Missouri allotment, in the Forrest Park ponds. The State Commission, of which I was one, went to St. Louis and insisted on having our share. The ponds were seined and I think I managed to get ninety-two of our allotment. Twenty-two of these were placed in the Sni Ecarte to save them, and the rest were issued, in lots of five, to various applicants. The next season the U. S. Commission had a large supply and Illinois was given a generous amount, so that every applicant possible was supplied.

Again the effort to get something for nothing prevailed, and any old mud hole was utilized to raise the carp in. Hogs, and stock of all kinds, ducks and geese, had access to these ponds, but the carp, true to their nature, lived and grew fast, and as spring approached, began to show on the surface of the waters. From these conditions they were taken and cooked and naturally proved a disappointment, soft, oily and muddy in taste. With the help of the county papers they soon got a bad reputation, and why not? Black bass, under the same conditions, would do the same. Then the ponds were neglected and soon became broken, and the carp escaped into the creeks, and from thence into the larger streams, until in time they became well and thoroughly stocked with carp. Fishermen began to take them, but threw them away as worthless, for their name had gone before them; with so much adverse criticism they had been condemned from the start.

Then followed a year in which more intelligent attention was given them. Men made ponds for fish culture and gave their fish the same chance they gave their stock or poultry, good

food, good water, and intelligent care. When they were wanted for the table they were properly treated and properly cooked, and they found the carp at least on a par with the former favorite coarse fish, the buffalo, and gradually they came into more general use. The quantities obtainable attracted the attention of eastern parties, and investigation was followed by a steady market and demand for them. Carp have found their way into every city and town of the west, and on almost every table. Not always on the bill of fare as carp, but under various names, from carp to salmon, it is served to the public daily. All this has, of course, followed only as a result of a better knowledge of how to care for carp and how to cook them.

Now, we again find great concerns handling thousands of tons of coarse fish from the Illinois and Mississippi Rivers to the east, and thousands of men are given employment in the work incidental, and a number of towns are absolutely supported by this industry.

Gentlemen, conditions are following the text, the greatest amount of food for the greatest number of people for the least price is being produced, and the introduction of the carp is responsible for it.

It is not necessary for me to undertake to prove that, from a commercial standpoint, none of the other varieties of fish compare favorably with the carp as a money or food producer. speaking of Illinois waters only, but a constantly increasing supply of the gamier varieties goes to show that their introduction has not only given more food for man, but has increased the supply of food for the game fishes, as well.

I think I have shown that I am a friend of the carp for good reasons. It is adapted to such waters as the Illinois River and the lakes adjacent to it. It is in no sense a destroyer of other fishes, being a vegetable feeder, except as it disturbs the vegetable growths and, in a way, drives out some species into clearer water. It is of commercial value, being hardy, prolific and of rapid growth, and being tenacious of life is easily transported, and it is a good food fish, cheap and wholesome.

I am conscious that our state is especially fortunate in being able to supply the conditions most favorable to the successful cultivation of the carp, and regret that so many must, of neces-

sity, live in less favored localities, into whose waters the introduction of the carp would be detrimental, but without wishing to seem patronizing or boastful under superior advantages, I must insist that the work of investigation and introduction of the carp has been one of the best, in its results, of all that has been done by one of the greatest food producing factors of the world, the United States Fish Commission.

DISCUSSION.

President: In several of the former meetings of this Society, this carp question has been very prolific of discussion. It is now before you.

Mr. Meehan: This subject has been threshed out a good many times, but there is a little I would like to say. I have often heard that there are two things that it is idle to discuss, one is religion and the other is politics, for the reason that when two partisans of either get together, when they are through they hold the same position as they did before. I think we ought to add carp to that list. There was once a man who had a horse of which he thought a great deal and he was very enthusiastic about it. He got around among a lot of his friends one day and began to describe that horse and tell of its beauties, health, etc., and wound up by saying: "This horse is just about the right size, 16 feet high!" A friend said: "Surely you mean 16 hands." "Wait a moment. If I said 16 feet high that horse is 16 feet high, and it is going to stay 16 feet high." There is also an old Latin saying, De gustibus non disputandum; about matters of taste it is idle to discuss.

For these reasons it is really, I suppose, idle to have any extended discussion on this subject. But I have often wondered whether or not, in states where people are very friendly to the carp and strong advocates of it, the fish were different and had different habits in those states from what they have in my own. I must say that I have eaten Illinois carp, and have not found them any better than the carp taken from our own waters.

It has been said on various occasions by advocates of the carp, that they do not eat spawn. It has been said for years and years, and they have also stated that there has been no

proof offered that they eat spawn. In fact no later than yesterday, one of the members here made the statement in his paper, that all charges that carp eat spawn were mere pipe dreams. It must have been a pipe dream on my part then, for I have seen them eat spawn, I have written about it, I have stated it in the newspapers, in the fishing magazines and spoken of it to the people; and almost invariably the reply would be: "Well, this is the first time that any regular out and out proof has been given of the fact, but you must remember that other fish are cannibals, too." The trouble is, however, that in a few days we will find the very same people get up again and say, "There is no proof that these fish eat spawn." So I say it is practically idle to discuss the matter.

In Pennsylvania the carp do eat spawn, and the majority of the people of Pennsylvania believe that they live entirely on spawn. I do not agree with that, nor do I agree with the majority of the people in Pennsylvania in the statement that the carp is a principal factor in the decrease of the number of black bass. They are decreasing, but I do not believe carp is the principal factor. I think we must look for other causes. But we claim that carp is a nuisance in our streams; that it is one of the factors in some of the localities of the depletion of black bass and other valuable food and game fishes (and by valuable I mean not merely from a sporting standpoint, but from a food standpoint); and that it is therefore not a desirable fish in our waters.

I can very well understand how Dr. Bartlett could be a great friend of the carp in Illinois, from a money standpoint. Pennsylvania pays a great deal of money to Illinois for carp. The state of Illinois may sell from 1,000,000 to 2,000,000 pounds of carp to Pennsylvania, the bulk of which goes to Pittsburg and Philadelphia. Nevertheless, it is regarded by us in Pennsylvania, and is undoubtedly, a very inferior food fish. While we sell a great deal of carp in Pennsylvania, it is only sold to two classes of people, one a very estimable class, who buy the fish alive in order that they may kill them according to their religious rites; the bulk of the fish are, however, sold to what we consider largely a very undesirable class of people, the Italians. The price is high, running sometimes as high as 16

to 18 cents a pound. But when they mix the fish up with potato, turnip, garlic, onions, herbs and bread, it makes a very cheap dish for them, and perhaps the condiments hide the muddy taste of the fish.

I think myself I am prepared to modify my former opinion of the carp for cultivation purposes, to this extent: If they can be kept or raised in ponds where they cannot get out into the open streams, and can thus be prevented from diminishing the supply of fish in those streams, I am in favor of so raising them; because I believe as long as an industry can be made out of any fish that it should be to a certain extent fostered. But it is not a suitable fish for the streams of Pennsylvania, most of which come from the mountains, naturally pure, and these fish befoul these waters.

They do destroy plant life. There is no question about that with us. It cannot be disputed in Pennsylvania that they destroy the water vegetation, and destroy it in large quantities. It is also undoubtedly true that they keep the water muddy and drive the bass and other fishes therefrom.

By destroying the vegetation in the water they destroy the minute animal life on which bass fingerlings thrive.

Not only bass but other and game fish are deprived of food and shelter by the carp.

It is for these reasons that I am not a friend of the carp, and why I have opposed its further introduction in waters, and why I have heartily approved in Pennsylvania of the enactment of a measure which makes it a misdemeanor to plant the fish in any public waters in Pennsylvania.

In short, I consider the German carp undersirable fish.

Mr. Atkins: The trouble seems to be that people allow themselves in matters of taste to be led by prejudice rather than be controlled by careful judgment. There is quite a general prejudice against the carp throughout the country; but in Illinois the carp is found to be a good thing.

It might be a surprise to some who are fond of black bass and have a high opinion of it, to know that there are sections of the country where for fifteen or twenty years past there has been constant opposition to the black bass. That is the state of

things in Maine. But the black bass is not to blame for that. It is a good fish, well worthy of introduction. But the people who first caught it were for some reason disappointed about it; or they did not catch the other fish that they had gone after; so they began to curse the black bass; and the next man caught the disease and the prejudice has become almost universal. I cannot recollect an instance of having heard any citizen of the state of Maine speak respectfully of the black bass.

Now I am inclined to think the trouble about carp arises somewhat from a similar source. People do not wait to investigate facts, but are contented to found decisions upon prejudice.

Secretary: For several years I have been very much interested in the discussions of the carp question before the Society, both on the part of those who favor and those who are opposed to the fish. I have noted this fact, that those who speak favorably of the carp speak by the card, they speak from investigation and actual knowledge. But I know that those who speak against the carp do not always speak from actual investigation. This state of things exists in my own state, where there is a strong prejudice against the carp. If I am present at some little gathering it frequently happens that somebody will start off with a tirade against the carp; but come to find out, he knows nothing about it; he assumes that the carp muddies the stream, and destroys the bass spawn. Certain people interested in fishing raised quite a large sum of money last year to seine out the carp from a small lake near Fond du Lac, on the ground that the carp destroyed the bass and the pickerel! They seined diligently for one week and did not find a carp in the lake. (Laughter.) Yet for several years to the presence of carp he has attributed the cause of the poor fishing in that pond. (Laughter.)

Lake Koshkonong is the Wisconsin home of the canvas back duck on its flight from the arctic regions to the south; and canvas back duck have been very plentiful there for fifty years, until within the last half dozen years, when perhaps they have been less plentiful. Shooting clubs and others interested laid the decrease to the carp. They did not realize that a law in the state preventing spring shooting had been repealed; they did not realize that there were ten guns where there used to be one;

that each gun went off about ten times as fast as it used to, and all that sort of thing. So they went at it to seine out the carp. While they were doing this a gentleman in Milwaukee of a scientific turn of mind, investigated the subject, and demonstrated that the canvas back duck did not eat wild celery at all; and that if the carp really destroyed the wild celery it had nothing to do with the duck question. That scientific assertion dampened the ardor of the duck hunters somewhat as to their charge against the carp; however, they went to work and caught carp with seines at Koshkonong Lake. But they discovered that there were more bass in the lake than there were carp. As a matter of fact, they caught comparatively few carp; and therefore the ground that the carp had destroyed the supply of the canvas back duck, does not seem tenable.

Now I am very much interested in this subject and have no prejudice either way. But when there is an under dog I have sympathy for him, and as everybody jumps on the carp, I have been waiting for some positive information, some real investigation, to prove that carp affected the breeding of other fishes, that they destroy the spawn of the black bass, or that they interfere with the spawning beds. Now I think that this paper of Mr. Cole's here, perhaps does not dispose of that subject entirely; but it certainly gives a good deal of strong evidence that carp do not affect the spawning beds of other fishes.

I wish if anybody has any positive information, the result of investigation on this subject, that we could have something definite before this meeting, so that we could tell whether carp were a real injury or not.

Mr. North: We have a great many carp in Ohio, and a very large industry around Port Clinton, catching and shipping carp. There is no question, however, but that the carp are very injurious to duck marshes. They feed on the wild rice, and the marshes are deprived of vegetation; and the ducks absolutely do not come to those marshes which they formerly used to frequent in great numbers; but it appears to me that the carp is with us, and is with us to stay; and you cannot exterminate it by talking. The only way to do is to educate a lot more Pennsylvanians to eat them, and thus reduce the supply. (Laughter.)

Mr. Meehan: It is possible that I may be among those who know nothing whatever about the carp, but one statement I would like to make emphatically, and that is, I have seen carp on many occasions eat spawn; I have seen carp on many occasions muddy the water greatly; I have seen carp root up water plants. I cannot make it too emphatic. I may not know much about the habits of the carp, but I can trust my eyesight.

I have among my force a superintendent who has also seen a great deal of that sort of thing; and a few moments ago he stated to me a matter that he had seen himself. In Lake Erie within a year, a twenty-pound carp which was caught, was found to be simply packed so full of spawn that when it was taken from the water the spawn poured from its mouth; and, furthermore, carp had been seen time and again in the waters of the peninsula adjoining Lake Erie, taking the spawn from the spawning beds.

Secretary: What kind of fish was on those spawning beds?

Mr. A. G. Buller: The carp was seen going on the beds of the pike and eating the spawn.

Mr. Whish: In view of the fact that the carp is an infernal nuisance, although his many friends do not believe it, I move that we lay the spawn matter on the table. (Laughter.)

THE POLICY OF CEDING THE CONTROL OF THE GREAT LAKES FROM STATE TO NATIONAL SUPERVISION.

BY MR. C. D. JOSLYN.

Mr. President and Gentlemen:—When I was called upon by our secretary some months ago to write something upon the policy of ceding to the federal government the control of the Great Lakes, I gladly assented, but according to my usual custom, put off the task until the last minute, and now I must confess that I have not written a paper, so must speak from notes written since I came here.

Until a few years ago, Michigan was engaged in raising and planting whitefish in the lake waters which well nigh surround her. It is safe to say that in this work she was very successful under the circumstances. But after a while we realized that the efforts of a single state, no matter how well directed, were wholly inadequate to meet the demands and accomplish practical results; that unless the work was systematically done all along the Great Lake chain, the work of one state alone would be of very little avail. So an agreement was made with the proper representatives of the federal government, whereby the federal officers took charge of our whitefish hatching stations, collected spawn of whitefish, lake trout, and wall-eyed pike from Michigan waters, and returned 75 per cent. of the product of that spawn to the lake waters bordering on the state. From that time on Michigan has had planted in the waters surrounding her, from 50,000,000 to 250,000,000 whitefish and other fry every year since, at a cost to her of, perhaps, $300 or $400 per annum.

At the present time it may be said that probably nearly all of the successful work in planting food fishes in the chain of lakes, is done by the United States government. That it has been successful is beyond a doubt. But the *ultimate* results will in a great measure depend upon proper protection to that work which the federal government is not now in a position to give.

Years ago in many places where whitefish were abundant,

the catching of them was so reckless and wasteful, that they were soon exterminated from those places. Now at many of those points they are reappearing, notably in the Detroit River. All of you who are familiar with whitefish planting know that a planted fish can be told from a native. We know that the fish which are coming in now are the results of planting.

When these fish appear in sufficient numbers they will again attract the attention of the fishermen and will be again exterminated. Without the power to protect its own work it is perfectly clear that even the United States cannot keep up and make good against the reckless destruction of fish that now goes on in that chain of lakes on which eight states border. Each of those states is interested in the great fishing industry in those waters, but every state in the Union is concerned in having the fisheries so conducted that the bountiful supply of edible fish which nature has provided, shall remain for the present and future generations.

In the very nature of things the laws of the different states intended to protect the edible fish supply, are not and never will be uniform. What one state deems wise another does not. Some have a closed season, others have not. Some have it at one time and some at another. The evils growing out of this situation have long been recognized, especially by those living around the lakes. Meetings have been held by representative men from the bordering states and from the Dominion of Canada, but no satisfactory agreement as to what should be done has ever been reached, nor has there been any uniformity of opinion upon the most important questions until last April. At that time such a meeting was held in Chicago and there appeared a determination to get together. The result of the meeting was that we did agree upon several recommendations to be made to the respective legislatures of the states represented. But the sad sequel of it all is that no two of the legislatures agreed to nor followed these recommendations. Some states followed some part of them, other states followed some other part, but there was no uniformity and no unanimity. So that we are just where we started —nothing accomplished.

In the meantime the food fishes, generally speaking, are disappearing from the lakes. Although the federal government

has been successful with regard to some of them, there are others which need looking after, and all sadly need protection which the states cannot give.

"Imported Russian Caviar" is made and put up at Grand Haven, Michigan! It is made mostly from sturgeon's eggs captured mainly from Lake Michigan, but to some extent from the other lakes. This industry has been carried on to such an extent that this valuable fish has been almost exterminated from these waters.

This is a subject which was under discussion at the meeting in Chicago, and a resolution was adopted recommending that there be a closed season for this fish for a long term of years—ten years, I think. Michigan recognized the importance of that recommendation and last winter enacted a law forbidding the taking of sturgeon for ten years. But, let me inquire, of what use is such a law in Michigan unless the other states and the Dominion of Canada do likewise? It is quite true that Michigan, with its two thousand miles of coast line, cuts a great figure in this matter, but it is absolutely idle to say that it alone can accomplish any lasting good.

There is another feature: Even if these bordering states could get together, there is yet Canada to be dealt with. From the head of Lake Superior to the foot of Lake Ontario, one side of this great chain of lakes, except Lake Michigan, is bordered by a friendly but foreign country. Friendly as our neighbors are, willing as they are to co-operate with us, it yet remains that no state can make a valid and binding agreement with Great Britain or any of its provinces. The Province of Ontario, and, I think, the entire Dominion of Canada, are very much alive to the serious condition of the lake fisheries; yet, without a valid treaty to bind them, their legislative bodies, like those of the states, are quite likely to yield now and then to the importunate demands which "vested interests" in the fishing industries may and sometimes do make.

In the circumstances, then, nothing like uniformity can be attained. Still, if the fish of our Great Lakes are not to be entirely destroyed, if they are to be propagated, planted and protected in these waters, so as to produce the best, or even beneficial results, it must be done in a uniform manner, under uni-

form laws, uniformly enforced. It is too plain for argument that this uniformity can only be brought about on our side of the lakes by our national government. So forcibly have these things come home to us who live on the lakes, that at the meeting in Chicago which I have mentioned, it seemed to be the unanimous opinion of those present, that the entire matter of propagating, planting and protecting fish in our inland seas, should be put in the hands of the federal government. This is certainly and surely the only means of saving the food fishes which naturally thrive in them, for those who are to come after us.

It remains to be considered whether this can be done without seriously infringing on the internal police powers of the several states. I most unhesitatingly assert that it can. It will be remembered that quite a number of the powers granted the federal government in the United States constitution were given only after acrimonious discussion. Grave fears were expressed that these powers would destroy the right of the state to regulate their internal affairs. But we know now that they have not. Who now doubts the wisdom of the commerce clause of the federal constitution under which President Roosevelt broke the Northern Securities monopoly. Under it Congress has again and again asserted its right to regulate interstate commerce; yet the Supreme Court of the United States has many times upheld state police regulations of such traffic.

A few years ago the state of Alabama enacted a statute imposing a penalty of $100, I think, upon telegraph companies which should negligently fail to deliver a message within its borders. A suit was brought against one company to recover such penalty, and it undertook to defend on the ground that the Alabama statute was an interference with interstate commerce. But the Supreme Court of the United States said it was not; that Alabama had a perfect right to inflict a penalty upon the company for not carrying out its contract within her borders.

The federal government carries our mails and regulates their use, and no honest person is harmed by this exercise of federal power.

In fact the people would not now tolerate state regulation of our postal affairs. Federal courts are given jurisdiction in all

admiralty and maritime matters, but no one has ever supposed that such jurisdiction has interfered with the laws of any state on the subject of water-craft, nor with its criminal courts.

Moreover, the matter of preserving the food fishes in the Great Lakes is not merely a state matter. It is one which concerns the entire country; it affects all the people of the country and is therefore a question of national importance. The nation only can deal with it successfully.

May I add a word of sentiment?

I will allow no one to go before me in giving allegiance to my own state. If ceding control of the Great Lakes to the federal government for the purposes just spoken of would in the least interfere with the right or power of Michigan to manage its own affairs within its own borders, then, emphatically, it should not be done. But our experience shows conclusively that it will not.

The structure of our national government is upon foundations laid deep and strong. To my mind the master builder was John Marshall of the Old Dominion state.

It was he who demonstrated to the judicial world that the federal constitution created a nation and contained within itself the power of self-maintenance; that it was not constructed for a day, but for all time. The arbitrament of the sword subsequently demonstrated its physical power.

While each state is a perfect entity with plenary and exclusive power to regulate its own domestic affairs, yet each most loyally yields to the federal government, full and ample power to sustain itself as one of the great and independent nations of the earth.

Jealousy of federal control should no longer enter into the discussion of a question of this kind. We are one people. We are not strangers to each other. The citizen of Michigan is at home and among friends and neighbors in West Virginia, and the West Virginian is equally at home and among friends and neighbors in Michigan.

Our interests are common. Our hopes and our aspirations are everywhere the same. The question of state advantage no longer troubles us. What is the best for *all* is now the question which the true statesman considers. East, west, north and

south all subscribe to the great underlying principle—the greatest good to the greatest number. Our state governments have become permanently welded together into one nation now known and honored as the foremost in all the world. Every citizen of every state is a patriotic worshiper and defender of his country's flag. Everywhere we teach our children to respect and revere it. Every American citizen is proud of his country and proud that it has produced a Roosevelt.

Shall it be said, then, that we fear to make its banner the emblem of authority on our great inland seas over which ride more ships than enter and clear any port in the world? Most surely not. We are not afraid of federal power. We are not afraid of federal encroachment. We stand uncovered before the old flag; the new flag; the flag of the future! Now, as it always has been, always shall be, the flag of the free.

"Flag of the stripes of fire!
Long as the lofty bard his lyre
Can strike, Thou shalt inspire
Our song.
We'll sing Thee round the hearth!
We'll sing Thee on strange earth!
We'll sing Thee when forth to battle we go
With clarion tongue.
Flag of the free and brave in blood,
Be Thou for aye the blest of God."

PROPAGATION AND CARE OF YELLOW PERCH.

BY NATHAN R. BULLER, PLEASANT MOUND, PENNSYLVANIA.

Yellow perch is as widely known as the sun fish sometimes called yellow Ned. Unlike some fishes called perch it is a true perch with the black bass and rock bass as near cousins. It is one of the purest types of the family. It is, in fact, the most perfect type that swims in American waters. It is one of the original representatives of the genus. Far back in the earlier ages of the world, during the period the geologists call Devonian, when fishes were the dominant form of life, perch of a character almost identical with the yellow perch of to-day, formed part of the family.

The yellow perch is found in nearly all the waters of Europe and those of Eastern America, from Labrador to Georgia, and in my opinion should be more extensively propagated, and by successfully doing this it can be made to become commercially valuable as well as affording ample sport for the disciples of Izaak Walton.

By the advice of my chief, Hon. W. E. Meehan, I have taken up the study of the yellow perch, to find out economical methods of propagation, and I will relate what my efforts amount to thus far, and I trust there will be discussion had and ideas advanced by those present who have made efforts in that direction.

In order to demonstrate that yellow perch could be placed in ponds and artificially fed, I placed 500 in a pool 150 feet long by 45 feet wide, varying in depth from 4 feet to 12 inches. We commenced to feed with ground liver and found that in the course of time the fish took it very readily. From all appearances they thrive and continue in a healthy condition.

These fish, which were yearlings and two-year-olds, were placed in a pool one year ago and are the fish that I received my eggs from, but I would advise that the parent fish should have very large ponds, covering four or five acres if possible, certainly not less than one-fourth of an acre.

April 15 the ice left my pond and shortly afterwards I found perch in the act of spawning, which continued on until the 12th of May. Most of the eggs were gathered in strings after the fish deposited them on the branches which I placed in the ponds for that purpose, and they were therefore very easily collected. When the intention is to hatch in a pond instead of allowing the eggs to remain on the branches, gather them and place on egg trays, allowing the trays to float loosely over the pond, the action of the waves will keep the eggs free from sediment.

At the present time I am unable to say how successful my pond work will be, as I do not intend to draw off the water until the month of September.

The method that appeals to me as being the proper one to pursue, is the using of a series of troughs 16 feet long, 18 inches wide and 8 inches deep. Eggs can be placed in the troughs on trays. A trough of the dimensions I have mentioned has a capacity of 10,000 perch until they are three months old. They will readily accept milk-curd as soon as the sac is absorbed. I continued feeding the curd until they were twelve days old, and after that I fed them on ground liver, which was taken very readily. In my observations I have not found any disease of any kind to attack them.

I have also been watching very closely to discover any indications of cannibalism. Thus far I have not detected any.

I verily believe that by using these methods and growing the fish to the size here exhibited, our rivers and inland lakes will soon again teem with these fish.

DISCUSSION.

Mr. Buller said while reading his paper: I have a few specimens in a bottle that I have fed on milk curd and beef liver.

(Exhibited.)

I know these can be hatched in jars.

There is a chain of lakes in the state of Pennsylvania covering five counties, and these lakes are kettle holes, varying in size from 150 acres to a thousand; and I think there are 192 in the chain. Long years ago these lakes were practically all inhabited by brook trout, but by the denuding of the forests the brook

trout have disappeared, and to-day they are inhabited by yellow perch, pickerel and bass. The object of this work is to discover methods to grow these perch economically, and restock these lakes by changes of blood from one lake to another, and if anyone has done any work in this respect we would like to hear from him.

The eggs are placed on the trays in lace form; and another thing that I observed of this matter is this: I had placed grasses in the ponds and eggs were deposited on the grasses; but I found that the action of the waves had taken a great many of the eggs off the grasses, and they fell to the bottom and smothered; but by measuring them up after the fish had spawned and placing them on the trays, that was avoided, and for that reason I used the tray.

Mr. Harron: To handle yellow perch eggs on troughs would require a great many troughs, would it not?

Mr. N. R. Buller: They can be easily handled.

Mr. Meehan: Is not the trough made particularly intended for the purposes of distribution in our inland streams?

Mr. N. R. Buller: Yes. To plant the fry in large quantities it is necessary to use jars. The trough would not be practicable for that purpose.

Mr. Harron: I undertook to hatch them at our station, but found I could not do so. You can easily develop them in troughs, but you cannot hatch them loose in troughs, I understand, for they become like a mass of jelly, and so buoyant that they will float down and constantly clog the screens.

Mr. Buller: I have found no trouble in handling them on a tray.

Mr. Titcomb: How many to a tray?

Mr. Buller: About 50,000. I intended merely to raise 10,000 fingerlings.

Mr. Titcomb: Did you raise 10,000 fish to the fingerling state?

A. Yes.

Mr. Harron: They did nicely until about ready to hatch, and then we had to transfer them to our collector courier, and they were placed in there as a solid mass, and hatched out 88%. But it requires constant care and attention to prevent smothering from dead corners of waters, that is, where there is not a complete circulation of water through the bottom of this tank. My idea is that the best way to handle perch eggs on a large scale, is in an open mouth jar with a spout attached so as to pass the young from the hatching vessel to the receiver.

Mr. Buller: I agree with you, when you hatch the fry in large numbers.

Mr. Titcomb: It is remarkably good work to handle 10,000 fry in those troughs. What is the loss?

A. The loss is very light.

Q. Do you count out your fish?

A. Yes, sir.

Mr. Titcomb: I think that is remarkable.

Mr. Buller: I found very little trouble after the sac period. They took food very readily and I brought up these questions because I think the matter is very important to our inland lakes.

Mr. Meehan: Did you not find this successful on a large scale, I mean the mere hatching, by using the trays on the ponds as you describe, simply putting the eggs on the trays and allowing the trays to float loose on the pond?

Mr. Buller: Yes.

Mr. Meehan: There is another question and that is the temperature of the water. We found where the water was cold, just about the time the eggs were hatching out, a large number of fry died. It fell to 44° and little fish died by the thousand.

Mr. N. R. Buller: I took some of the eggs over into the trout department, put them into those troughs, and the temperature of my spring water at Pleasant Mount, is 47°; and they all died in twenty-four hours.

Mr. Harron: At what temperature did the fish begin spawning?

Mr. Buller: I dont know what the temperature of the pond was.

Mr. Harron: My experience is they begin always at 42°.

Mr. Buller: I notice in all our lakes, as soon as the ice has left the lakes, the fish commence to work.

Mr. Titcomb: Did you try transplanting the yellow perch eggs in considerable numbers any considerable distance?

Mr. Buller: No, but I have taken the time and have held them on the trays for forty-eight hours.

Q. In water?

A. No, sir, with a dampened cloth, and also had them in cans the same length of time in water, but a great many of them smothered. But on the dampened flannel trays they were all right.

Mr. Meehan: We shipped some eggs from Erie to Bellefont, about 250,000, in cans. Many of them hatched on the way, and the bulk of the eggs that arrived were dead.

Mr. Titcomb: Did you aerate the water?

Mr. Meehan: Yes. In one instance I accompanied the eggs myself. It was remarkably cold all the way through. The temperature of the water remained stationary, 44°, from Erie to Wayne; and the fish began to hatch shortly after the car moved; but they died almost as fast as they hatched, and before we reached our destination nearly all the eggs that were not hatched were dead.

Q. Do you consider the experiment conclusive?

Mr. Meehan: I should call the shipment of eggs in cans in this manner, a failure under those conditions.

Mr. A. G. Buller: How do you place your eggs, in jars?

Mr. Harron: I hatched them nearly all in the open tanks.

Mr. A. G. Buller: What would be your method of putting

your eggs in the jar when you use the jar? Do you just lay them in the jar?

Mr. Harron: I place them in the jars, just let them drop right in, without suspending them from a string, placing about 260,000 eggs in a jar.

Mr. A. G. Buller: I tried that in the Erie hatchery and I found when the fish were about ready to hatch out that they were smothered, and few eggs came out, and what did not come out were smothered. Perhaps I did not run enough water.

Mr. Harron: I ran about two gallons. In the future I propose to hatch them all in the jars.

Mr. Buller: My experience was that about the time they were hatching out they died. What few came out died and what did not come out smothered in the egg.

Mr. Harron: The fry rise very readily after hatching, and there is no reason why they should die in the jar.

Mr. Buller: Probably I did not have enough water running.

Mr. Titcomb: At another one of our stations we decided that the open pump, Downing jar, is the best thing for hatching yellow perch eggs. I hope that there will be further experimentation on the subject of transportation. It is possible for the bureau to go to the head of Lake Champlain and take hundreds of millions of yellow perch eggs. The yellow perch on Lake Champlain is a drug in the market. When the water rises in the spring these perch go into marshes and spawn, and the spawn is left hanging on the weeds as the water recedes; so it is possible to collect hundreds of millions of eggs—gallons and gallons of them.

Mr. Meehan: We intend to pursue this matter, because of the conditions that exist in portions of our state. With us it is a question of propagating these fish in enormous quantities. We must do it. It has come to a point where for a greater part of the state it is necessary to hatch them in that way, and we intend to limit ourselves by our capacity to get them out, so that it will become a question of successful transportation.

Mr. Downing: A few years ago I had a little experience in

hatching yellow perch. I did it as an experiment. I was engaged in another work, but I had a chance to get a few of the eggs, and I carried them from North Bass Island to Sandusky, in a pail and in a pan. When I got to Sandusky I found a large part of the eggs stuck to the bottom of the pan, and I saw that if I removed them from the pan I would injure them, and I left them in the pan and turned a small stream of water on them and arranged them so that the water would go into a screened box; and the others I put into a jar. In putting them into the jar I let them wind right around the tube, and in eight days they hatched, and so far as I could see they hatched 100%. I did not see that any died or were wasted; and it seemed to me at that time, that it was a very easy matter to hatch that kind of fish.

Mr. Harron: I would like to ask Mr. Downing if he noticed the temperature of those that hatched in eight days.

Mr. Downing: Pretty high—about 70°. That was some time ago and I do not exactly remember the temperature.

Mr. Harron: My experience is that it takes the yellow perch egg 10 to 20 days to hatch out at a mean temperature of 47° to 54°.

Mr. Townsend: We have had a half bucket full of eggs which kept in good condition and 30,000 to 50,000 hatched out each season.

Mr. Buller: How far had the eggs advanced?

Mr. Townsend: They hatched pretty promptly. The further the eggs are advanced the harder it is to transport them.

Mr. A. G. Buller: That was the trouble with the eggs that Mr. Meehan took; they were hatching on the way; and also with those that I sent to Bellefont—they were practically all hatched out. The eggs Mr. Nathan Buller spoke of were green eggs and not difficult to carry; but as for carrying them any distance on trays when they are ready to hatch I do not think it can be successfully done.

Mr. Meehan: There does not seem to be any limit in reason to the number of yellow perch that may be carried. You can carry nearly as many yellow perch in a pond as you can of trout

relatively. They do remarkably well, and feed on the same food readily.

Mr. Nathan R. Buller: Most all my eggs were gathered green, and I found the trays gave the best satisfaction carrying green eggs in water. While they had all the attention possible I found a great many of them were dead. I don't say carrying them half a day, but these experiments of holding these eggs were for a couple of days. And I have also taken the eggs from the lake and carried them on the trays and placed them in the evening, and had perch in the morning, and they went through successfully. I brought up this question about the perch in the pond because I believe that it can be made a very fine pond fish with pond culture, the same as trout, if we do not run up against something next year that we did not see this year.

Mr. Downing: I would like to ask if the eggs handled were taken from the fish?

Mr. Buller: Most of the eggs were gathered. I expressed some of the eggs; but the natural impregnation was much better than mine was.

Mr. Downing: In my experience I took the eggs from the fish.

Mr. Buller: The natural impregnation was better than mine.

Mr. Lydell: Some years ago when I was collecting wall-eyed pike spawn in the Saginaw district for the Michigan Fish Commission, I had opportunity to take a great many perch eggs, and we used to strip them as they came aboard of the boat in great numbers and turn them over into the bay. At one time we stripped a large pail full of them and sent them down to the hatchery at Detroit. We took the eggs ourselves right from the fish and put them in a jar that had some cross-sections in it, and the eggs were wound around in there so that they could not float up against the screen. They apparently did hatch, and after the last egg had hatched, I either drew upon my imagination a great deal, or they seemed to commence hatching from the gelatin after that. (Laughter.) I did not know exactly when it was going to stop.

Mr. Whish: In New York state the yellow perch is a favorite fish, and although we do not attempt to raise them we distribute them, because we find that where there are a lot of yellow perch to be caught in the ponds, the small boy and the average fisherman are satisfied to catch them, and do not bother the better class of fish. There are certain small streams running into one of the lakes, and in these streams the small perch seem to come up from the lakes. I have always thought they came up to escape the large fish. At any rate, we take advantage of their coming and simply go there with a little net and cans, and scoop out millions of them in the fall and ship them as fingerlings. I might also say for the edification of the yellow perch brethren, that I would as soon catch yellow perch on a light rod as trout. "If that be treason, make the most of it." Yellow perch sometimes grow to a weight of four pounds in New York state, and if any gentleman wants to know where those perch are found, I will send him a map of the district.

Mr. Meehan: I think one of my superintendents, Mr. William Fuller, of Corry, was the first in Pennsylvania to begin the work of experimenting on yellow perch, and he will tell you something about expressing the eggs from the fish themselves.

Mr. Buller: I had no trouble in placing them and they fertilize just as well as any.

Mr. Harron: I think Mr. Downing spoke of the egg sticking. I have made some little experiments with the impregnation of the eggs, and I found that it was always the case that they did stick for a while. In the case of the eggs that I collected from the fish, whenever I would hoist the car to take out the eggs I did not find a single string attached to the car. They were all loose and floating buoyantly over the bottom.

Mr. Downing: One reason that they stuck so persistently to the bottom of the pan was, that the pan was a little bit dry when the eggs were put in, and they adhered to the bottom and they stayed in the pan till they hatched, and they hatched as well out of the pan as out of the jar, and apparently they all hatched.

NOTES ON THE TAKING OF QUINNAT SALMON EGGS.

BY WARD T. BOWER.

The quinnat and other salmons of the Pacific are now well established as a staple article of food throughout most civilized countries; and to the extent that they can be produced at a reasonable price to the consumer, the demand for this valuable food staple is certain to grow as population increases. It is evident, therefore, that to maintain a normal balance between consumption and supply, the latter must be greatly increased as time goes on. The future of an important source of food wealth presents a serious economic problem, the solution of which it is now generally conceded depends in a great measure on fish cultural effort.

Assuming then that the future of the salmon industry rests quite largely on hatchery propagation, it is timely to inquire whether production in this way may not be substantially increased through improved methods that practically eliminate all loss prior to the eyeing stage of the ova and, though perhaps of less importance, incidentally effect substantial economies in the cost.

My experience in salmon culture leads to a positive conviction that the single feature of releasing the ripe ova by incision and gravity rather than by expression, effects a saving of 5 to 15% of the ova and reduces the cost of production to the eyeing stage at least 33 1-3%. It is this point that form the basis of the account which follows. Barring perhaps some minor details, no claim is made to originality, for taking salmon eggs by incision has been tried in various ways by others, though perhaps not on so large a scale and during a full season's operations. It is the purpose to describe briefly what may be termed the old and the improved way, make comparisons and submit the results as evidence of the superiority of the one over the other.

In the fall of 1903 and again in 1904, the writer was in immediate charge of the U. S. Bureau of Fisheries Sub-station at

Battle Creek, California, where quinnat salmon have been propagated for a number of years.

A barrier is placed across the stream at this point to prevent the ascent of the fish to their natural spawning grounds immediately above. Below this barrier or rack for a distance of about two and one-half miles to where Battle Creek empties into the Sacramento River, the current is moderate, the stream broadens and is much deeper in places.

About one-half mile below the closed or upper rack, a second or retaining rack has been placed across the stream, so arranged as to permit free entrance to the fish and yet preventing in a great measure their dropping back. The fish are taken by seining at various points between these racks, and range in size from about ten to forty pounds, the average being about twenty. The method of taking the eggs in 1903 is practically the same as had been employed for several preceding years. The ripe females, as fast as caught, are transferred to pens, whence all are removed daily and spawned. The crew for this purpose consists of ten men, as follows: One man to dip the males, one the females, one tail-holder, one head-holder, one stripper for females and two for males, one egg mixer and two egg washers.

A female is dipped from the pen and the net handle so balanced on a rest that the fish is swung a few inches above the floor. While in this position it struggles violently, but is seized at once with both hands by the tail-holder, who wears woolen gloves to secure a firmer hold, and raised to a vertical position. The head-holder, with hands protected by heavy horse-hide gloves, then grasps the fish by inserting his thumbs in its mouth and his fingers under the gills. The tail-holder, resting upon one knee, brings the tail of the fish to the floor and the vent just above the edge of the spawning pan, a rectangular vessel similar to the ordinary breadpan. The latter is placed in a frame to prevent overturning should the fish slip from the grasp of the attendants. The stripper then expels the eggs in the ordinary way, passing both hands two or three times down the full length of the abdomen. As a twenty or thirty-pound salmon has great strength and remarkable contractive powers, it is generally necessary for the stripper to exert his utmost strength to start the eggs, even when they are fully mature; in fact, strength

rather than skill is necessary at this stage. The eggs are then fertilized in the usual manner, a number of males having been thrown out on the platform a sufficient length of time to allow them to become exhausted, and they may be easily handled. The egg mixer stirs the mass in the pan with his bare hands and the pan is then transferred at once to the washers. The eggs are cleansed immediately and turned into buckets, which are placed on an independent platform to prevent loss or injury through vibration or concussion during the extremely delicate stage of adhesion and separation, or until they are fully hardened.

For a number of years past, up to and including the season of 1903, it has been the practice at the Battle Creek station to return all females as they are stripped to a separate pen; then, after the day's stripping is done, throw them all out and kill and open them to secure the 10 to 15% of eggs that remain after stripping or that cannot be obtained by pressure. The eggs taken by this secondary process, designated by hatchery employes as "butchered eggs," are not equal in quality to those stripped, though nearly so, and are well worth saving. The heavy pressure exerted on the vital organs of the fish during the process of stripping releases a considerable quantity of blood and foreign matter, which mixes with the eggs and necessitates the time and trouble of washing them several times in a normal salt solution.

Fishing and spawning operations at the Battle Creek station were carried on during the season of 1903 as above outlined.

During the season of 1904 the fish were caught in the same manner as in 1903 and preceding years, but a radical change in one important point of spawning the fish was decided upon. Instead of forcing the bulk of the eggs by main strength and securing the remainder by opening the fish, they were taken by the simple method of incision and gravity. The spawning crew is the same as under the old method, with the exception that one man, the head-holder, is entirely dispensed with. The female is dipped up as before, grasped by the tail-holder and laid on the floor. Immediately the man who occupied the relative position of spawn-taker in the old method, strikes a sharp blow on the back of the head of the fish with a hammer, causing instant death. The tail-holder then releases his hold and inserts

one finger in the gill opening and raises the fish to an upright position, the vent being above the edge of one side of the pan with the abdomen towards the "spawn-taker." The latter, in a kneeling posture, grasps the tail with his left hand in order to keep the fish from swaying, while with his right hand a knife is inserted between the pectoral fins, and with a single vertical movement of the arm an incision is made down the entire abdomen of the fish to about one-half an inch to one side of the vent. The eggs immediately pour in a mass into the pan below, gravity being the only force exerted upon them. They are then impregnated in the usual manner. An ordinary pocket knife is used for cutting, the end of the blade having a keen edge to facilitate the rapidity of the work. It is essential that not over an inch of the blade be allowed to penetrate the fish, for fear of cutting some of the eggs. This is easily managed by firmly grasping the blade an inch or less from the point between the thumb and forefinger, which serves well the purpose of a gauge while making the cut.

Practically no blood falls into the pan following a quick, sharp incision, thus avoiding the necessity of previously bleeding the fish. In the methods of incision heretofore tried—most of which have been in an experimental way—it seems to have been considered necessary to bleed the fish before making the cut for eggs. But in practice it is found that but a mere trifle of blood flows from a simple incision of the abdominal walls, so long as no vital parts are cut or forced. Preliminary bleeding appears to be a waste of time and effort without any advantages.

The point may be raised against the plan of killing the fish in advance of taking the eggs, that considerable loss may be occasioned by killing green fish, whereas in the old way the fish could be tried and then returned to the water if unripe. In practice, however, we find that if ordinary care and skill be exercised in sorting the fish at the time of capture, the number of green fish cut is reduced to an insignificant minimum.

The total number of females stripped during the season of 1903, when the eggs were taken by stripping followed by cutting, was, in round numbers, 4,200; total number of eggs taken, 27,343,000; eyeing percentage, 79.

During the season of 1904, when the method of incision and gravity was tried the first time for a full season's operations, the number of females stripped was 9,400; number of eggs taken, 58,068,000; eyeing percentage, 97½.

In making a comparison between the fishing and spawning work of the two seasons, it is only fair to state that weather conditions were considered somewhat better in 1904 than in 1903. The increased catch in 1904 was not due to a heavier run of fish but to the fact that in 1903 a sudden flood carried away the upper rack in mid-season. But so far as spawning results are concerned, if there was any advantage in 1904 over 1903 it was probably offset by excessive crowding in the hatchery in 1904 and also by the bad condition into which the hatching equipment had fallen for want of an appropriation to replace it.

The most striking point of advantage of the new method is the improvement in the quality of eggs obtained, the loss under the old plan being 21% in 1903, while under the new plan it was a trifle less than 2½%. No doubt the difference would not be so great every season, but the writer firmly believes that the eyeing percentage should never fall below 95 with the improved plan, under any and all weather conditions.

It seems reasonable to assume that the improvement in the quality of the eggs is due chiefly to the elimination of the heavy pressure on the soft and delicate ova, that is necessary to start the flow. It is true that as soon as the eggs are started the pressure may be somewhat lessened, but a great deal of force must still be used to resolve the mass of eggs into a small liquid stream through the vent. The unnatural force thus brought to bear unavoidably subjects the eggs to the danger of crushing and straining, and also starts and expels a part or all of the green eggs that should not and need not be taken. Incidentally it should be noted that a limited number of green eggs are present in nearly all salmon spawned at the right time, for if the taking of the eggs is deferred until the last one is ripe, loss by hydration of those nearest the vent frequently occurs.

That some eggs are crushed in stripping is evidenced by the fact that shells are washed from nearly every pan; and it seems reasonable to suppose that a pressure sufficient to rupture even

a small percentage of the eggs is responsible for additional loss before the eyeing stage, if not afterwards.

But if there were no improvement in the quality of the eggs taken by direct incision of the female, the saving in labor and expense by this method strongly commends its general adoption in quinnat salmon work. The old plan requires two handlings; first, to spawn by hand, and then to kill and cut for the purpose of securing the remaining 10 to 15% of so-called "butchered" eggs. With a well trained crew it requires but little more time to take all the eggs at one handling by the clean and quick method of direct incision than it does to take the "butchered" eggs; thus one handling is entirely cancelled. In practice, we found that 100 females are spawned by direct incision in less than one-third the time required by hand stripping followed by cutting.

Furthermore, the old plan required two crews, one for fishing and one for spawning, the latter sometimes making a few seine hauls near the close of the day. In 1904, working under the new plan, the regular fishing crew was entirely dispensed with, and a single crew attended to all of the fishing and spawning, the daily spawning work being ordinarily cleaned up by 9 o'clock in the morning. Seven less men were used for this work in 1904 than in the preceding year.

Another considerable item in the line of economy appears in the hatching house. To eye the 58,068,000 eggs on a 97½% basis means that only one-ninth as many eggs must be picked out by hand as though the eyeing percentage were only 79. If we concede one-third of the improvement in quality to weather conditions or other causes, there is still a heavy balance to the credit of the improved plan.

To sum up: In 1903, under the old plan, sixteen men in thirty days caught 4,200 females, from which 27,343,000 eggs were taken and 79% eyed.

Under the improved plan the year following, nine men in sixty days caught 9,400 females, from which 58,068,000 eggs were taken and 97½% eyed.

The comparison between the two seasons is a fair one, for although a sudden flood stopped the work thirty days after the

opening in 1903, the take of both eggs and fish was not equal to that of the first thirty days in 1904.

The operating cost of fishing and spawning in 1904 was approximately $12.00 per day less than in 1903, and this does not include the saving in the egg-picking account, which was about $10.00 per day.

Simplicity, expedition, a decided improvement in the quality of the eggs, and economy all the way to the eyeing stage—these are the salient points to the credit of spawning quinnat salmon by direct incision. The results speak for themselves.

COLLECTING, HATCHING AND DISTRIBUTION OF PIKE-PERCH: WHY THE GREAT LOSS OF EGGS.

BY S. W. DOWNING.

I shall make no apology for this paper, more than to say that our worthy secretary said "write" at the same time giving me the subject upon which to write, and the paper now before you is the result of that writing. But you must expect nothing flowery in this article; I tried that once and the result was such that I am willing henceforth to abstain from anything in that direction, the incident was this:

While in charge of the work at the Clackamas, Oregon station, I had occasion to visit a sub-station upon Elk creek, a tributary to Rogue river, and in a letter written home describing the Steelhead trout as seen trying to ascend the rapids, I borrowed from Quackenbos in his description of the "Golden trout" and wrote as follows: "The coloration is gorgeous beyond example, the deep purplish hue of the back and shoulders seems dissolved into a dreamy sheen of amethyst through which the inconspicuous pale lemon spots of midsummer flame out in points of lemon or vermillion fire, while below the lateral line, all is dazzling orange."

This was so entirely foreign to my plain way of expressing myself that my wife became alarmed, and in her next letter she said, "When I commenced reading your letter, I thought that you were describing a fish, but before I finished was not sure whether it was fish, a bird of Paradise or a rainbow, and I think that you had better come home at once, or use some other brand of liquor." This was enough for me, and I determined right there that from that time all my writing should be in the plainest language possible.

So I will endeavor in my weak way to first describe the manner of collecting the eggs.

The eggs collected by the force sent out from the Put-in-Bay station are secured from the fish caught by the commercial fisher-

men. A spawner, as the men comprising this force are called, going in each boat, and as the fishermen raise their nets and the fish are thrown into the boats, the eggs from the live ripe fish are collected. By ripe fish we mean those ready to deposit their eggs. I think that I can describe this process no better to those assembled here than to give the instructions that are handed to each new man that is put into the field, after first stating that each spawner is provided with an outfit consisting of a wooden pail, one or more wooden kegs, a dipper and two common milk pans.

Instructions to spawners: Take the eggs from *one* female if large, and not more than *two* if small, use plenty of milt, and stir with the naked hand carefully, being sure that the milt from the male fish comes in contact with every egg, let stand about half a minute, add a little water and gently stir again, then lower and empty carefully into the keg which has previously been partly filled with water. Continue this process until the keg has as many eggs in it as it will safely carry. After the eggs are all taken then add a little water at a time until the keg is full. In adding the water do not pour it directly onto the eggs, but against the inside of the keg. After the keg is full then pour some of the water off, being careful in so doing to not pour the water down so low that the eggs will be exposed to the air, as this will cause them to form into a cake at once. Continue to add and pour off water until the eggs are thoroughly washed free of milt, and hardened up, after which time change the water as often as once an hour while in your possession, or until you put them onto the trays for shipment to the station.

As will be gathered from the "Instructions to Spawners," some of them are located in fields near enough to the station so that the eggs are picked up by the boat kept for this purpose, and brought to the station in the kegs, other kegs being left with the spawners for the next day's collection; while others are sent to fields so remote that this can not be done, in this case the eggs, after becoming fully hardened up, are evenly spread on cotton flannel trays, the trays placed in cases made especially for the purpose, and shipped to the station. Owing to storms and other causes, the shipment of the eggs from the field is often delayed for several days, the eggs remaining in the cases during this time, and usually with no apparent bad results.

After the eggs reach the station they are washed off the trays into the large wooden tubs, the common wash tub being used. the name of the spawner and that of the fishermen from whom the eggs are obtained together with the date upon which the eggs are taken, are written on a card and attached to the tub, so that a record may be kept not only of the spawner's work but the date upon which the eggs are taken and the locality from which they came. The eggs are usually left in the tubs over night, the night watchman changing the water on them every hour. The next morning they are placed in the hatching jars, from three to three and a half quarts being placed in each jar. And right here is where the fish culturist's work begins, and we believe that all those who have propagated this fish will agree that it requires more work and vigilance to successfully care for a given number of quarts of the eggs of the Pike-perch than of any others that are hatched in jars. The farmer's boy in describing the work of "watching gap" while the grain is being hauled from the field, very aptly describes the work of the fish-culturist. The boy asked if the fence could not be put up so that he would not have to stay and keep the cattle out of the grain. His father said, "Oh pshaw, boy, that isn't hard work." The boy said, "No, I know it aint, but it is so d—d busy." And this is the case with the fish-culturist's work. He gets the eggs overhauled, siphoned off, and his jars adjusted to his satisfaction and is feeling pretty well satisfied with himself. He then goes away for a few minutes to attend to some other matter, and returns to find the jars full to the top and on the point of overflowing, the eggs in nearly a solid mass with little canals running through them from the bottom of the jars upward through which the water winds its devious way to the top; then there are cuss words, and a strong wish that all eggs of this class were in perdition, but it avails nothing, and there is nothing for it but to take down the jars, pass the eggs through the screen and set them up again.

This year, however, we have been bothered less with this banking in the jars than ever before, and we credit our freedom from it to the use of corn starch. Each spawner was supplied with a quantity of corn starch and instructed to place just enough of the starch in the water to make it of a milky consistency, then the eggs are taken according to the previous

"Instructions to Spawners," and placed in this starch water, milt and all and not washed until all the eggs were taken, when washing was commenced and continued until the water came off clean and clear, all the milt and starch having been washed out, after which the same care was taken with the eggs as though no starch were used, and the result was that the spawners had less trouble in the field, there was far less trouble with the eggs in the jars at the station than on any previous year, and as the number of eggs hatched was one per cent greater than ever before, we feel that there were no bad results from the use of the starch.

After the hatching, then comes the distribution of the fry. Experience has taught us that the fry of the Pike-perch carry the best at from twenty-four to forty-eight hours after hatching, and as nearly as possible the fry from this station are liberated at that age, and those liberated in Lake Erie, which usually constitutes nine-tenths or more of the hatch, are distributed by the regular force at the station and is accomplished in the following manner:

We have a small steamer which is operated in connection with the station and lies at the wharf but a few feet from the hatchery door. Upon the deck of this steamer are from 100 to 140 12-gallon wooden kegs conveniently arranged for filling with water and placing the fry in them. These kegs are first filled about half full of water, the fry is then dipped out of the tanks into wooden tubs, carried out to the boat and placed in the kegs with a dipper, care being taken to put as nearly the same number into each keg as possible, they are then taken out into the lake and liberated. This is done by pouring them out of the keg, water and all, into the lake while the boat is running at full speed. This scatters them effectually, as during the time that it takes to liberate a load the boat will have covered several miles, and the hatch of a single season is thus distributed over an area of from 80 to 100 square miles, so that the loss from being overcrowded is reduced to minimum.

WHY THE GREAT LOSS OF EGGS?

This is something that I am unable to inform you with any degree of certainty, but will give you the results of some of the

observations that have been made during the past few years and let you draw your own conclusions, or a discussion may follow that will clear the matter up more to your satisfaction.

Up to last spring I think that we were seeking, at least to a great extent, in the wrong direction for the solution of the question of what caused so large a per cent of poor eggs, and were putting nearly the entire blame upon the spawners, and every time a poor lot of eggs came in we would write to the field foreman telling him that such and such a man was sending in poor eggs, and instruct the field foreman to jack him up about it, the men always protesting that they were doing the best that they could, and as the same men were employed for the whitefish work in the fall, and usually sent in eggs of an excellent quality, I could not bring myself to believe that they would do good work in the fall and intentionally do poor work in the spring, so I commenced looking in other directions for the cause of the inferior quality of the Pike-perch eggs.

In the spring of 1904, I was directed to take six millions of Pike-perch eggs to the St. Louis exposition. These eggs were some of the very last eggs received at the station, and usually the last eggs taken are of a poorer quality than those taken earlier. However, these eggs were placed in the common field cases and crushed ice packed in the space between the trays and the inside of the case, upon arrival at the exposition grounds about thirty hours later the cases were opened and quite a quantity of ice was found in the cases, the temperature of the eggs being about 47 degrees. The eggs were taken out and allowed to stand until their temperature rose to nearly that of the water in which they were to be hatched, which was 62. The eggs were then placed in the jars and at the end of four days were nicely eyed, fully 65 per cent of them eyeing, while the eggs left at the station, collected on the same day as those taken to St. Louis, were twelve days in eyeing and the average hatch but 48 per cent. These results were so marked as to lead us to commence a research along the lines of temperature.

We first compared the record for the past five years at this station, taking the average water temperature during the period of incubation, and the per cent of eggs hatched, the results of this comparison are given as follows:

1901—Average water temperature 49½, gave a hatch of 55 per cent.

1902—Average water temperature 45 2-3, gave a hatch of 47 per cent.

1903—Average water temperature 47, gave a hatch of 53 8-10 per cent.

1904—With an average water temperature of 47, gave a hatch of 48 per cent.

1905—With an average water temperature of 48, gave a hatch of 56 per cent.

It will be noticed that during the hatching seasons of 1903 and 1904 the average water temperatures were the same, while there was a difference of 5 8-10 per cent in the hatch of eggs, and that while the season of 1901 had an average water temperature of 1½ degrees higher than that of 1905, yet the hatch of 1901 was one per cent less.

We think that these facts can be accounted for in this way: During the incubation of 1903, the water temperature during the first three days ranged from 39 to 40½ degrees, from which time it steadily increased until the eggs were hatched, while during the incubation of 1904 at the receipt of the first eggs, the water temperature stood at 39½, rose to 40 the next day and then dropped back to 39 and remained at that mark until the eleventh day of incubation. And during the season of 1901 the lowest water temperature was 41 degrees, while during the season of 1905 the lowest water temperature was 42 degrees, remaining at that mark but one day, after which time there was an increase.

Continuing the inquiry along these lines, we find that the Pike-perch eggs which were sent direct from the field to the Pennsylvania commission and were hatched at Erie, Pa., during the season of 1904 in water of an average temperature of 49 degrees gave a hatch of 68 per cent, and during the season of 1905 the water temperature at Erie stood at an average of 50 degrees, and the eggs shipped in the same manner as on the previous year resulted in a hatch of 80 per cent, while at Cape Vincent, N. Y., eggs sent from the same field and collected by the same spawners, and hatched in water with an average temperature of 43 degrees, yielded a hatch of but 20 per cent; also a record of 10,000,000 Pike-perch eggs sent direct from this

same field to the Duluth Minnesota station in the season of 1904 resulted in a hatch of but 38½ per cent, and while the water temperature at this place is not known to the writer, it is presumed from the geographical location that it is lower than at either Put-in-Bay, Ohio, or Erie, Pa.

We also have a record of 10,000,000 Pike-perch eggs shipped to Mr. M. E. O'Brien at St. Joseph, Mo., during the season of 1902 and hatched in water with an average temperature of 54 degrees, which gave a hatch of 80 per cent. We have still other records at the station, all tending in the same direction, but we feel that enough has already been given to show that the higher the average water temperaure during the period of incubation, the greater will be the percentage of eggs hatched.

During the past hatching season the writer was asked if a water temperature of 40 degrees and below was not fatal to the eggs of the Pike-perch, and while my temperature records showed that the temperature had been as low as 39 for several days at a time during the season of 1904 and that our hatching record for that year showed a hatch of 48 per cent, yet to determine if possible how low a water temperature the eggs of the Pike-perch would stand, we had seven quarts of eggs placed in a keg, and by the use of ice the water temperature reduced to 38 and held at that mark for a period of 48 hours, when the temperature was allowed to gradually rise until it reached the normal. The eggs were then placed in the hatching jars and the same care given them as was given the other eggs, the result was that 12 per cent of these eggs hatched, proving that while a water temperature lower than 40 degrees is not necessarily fatal, yet it is very injurious to the eggs, and we do not doubt but that if the eggs have been carried in water of a temperature higher than 40 degrees until after segmentation is well advanced, and then the temperature drop to 40 degrees or lower, the result would be fatal. However, we have not seen this point tested.

During the first few days of the past spawning season the weather was fine, and the eggs sent in by one of my most experienced men were of a very good quality. The weather then turned colder accompanied by snow and rough weather, and the eggs secured by him during this cold snap were nearly worthless. Also the eggs secured by others of the force whom I knew to be

earnest painstaking men, proved to be no better, and from the facts given in the foregoing statements we have arrived at the conclusion that the "Great Loss of Eggs" is not due so much to the manner of manipulating them at the time of taking, and carelessness in subsequent handling, as to the weather conditions, and the consequent effect upon the water temperature after they are placed in the jars, and during the process of incubation.

However, we would not abate one whit from the former care and vigilance practiced in the field, but continue to be as careful and painstaking as possible in every detail, and then hope for the most favorable weather conditions afterward.

DISCUSSION.

Mr. Whish: The state of New York began hatching pike-perch eggs in 1894. The highest take of eggs since the Constantia Hatchery was established was 78,000,000 this season. We base our estimate as to the number of fish we will have for distribution, in getting the application blanks ready for the hatchery, at 60 per cent, and for several years it has been 70 per cent.

Mr. Clark: The paper by Mr. Downing is very interesting indeed, and to me at the present time probably more so than to any other member present, as last spring I collected a large quantity of pike-perch eggs. Of course previously we had collected a great many, but not to so large a scale as this past spring. From the title of the paper, I was in hopes that some of the problems in regard to the great loss might be solved. However, considerable light has been thrown on the subject.

Mr. Downing speaks of the question being asked if a temperature of 40 degrees was not fatal. This was brought up in the correspondence between myself and the Washington office, and at that time I stated in my report that the low temperature was causing a loss. Later on I revised my opinion in this regard somewhat; still I think that there may be times (as Mr. Downing says) when the low temperature may be very injurious.

I wish to state here our experience last season. We took all told, 370,000,000 pike-perch eggs, at two field stations, one being on Saginaw Bay where we gathered the larger number—I think

a total of about 325,000,000—and the other on the St. Clair river. The 325,000,000 collected in Saginaw Bay were taken under circumstances similar to those under which Mr. Downing collected his—from the boats of the fishermen. Out of 197,100,000 green eggs we succeeded in eyeing but 21,150,000, about 10 per cent. The percentage of eyed eggs has always been low in Michigan, but I think never before so low as this.

We want better eggs from Saginaw Bay; for even larger quantities can be taken there than in Lake Erie.

After completing the work at Saginaw Bay, I sent the force to Robert's Landing on the St. Clair river. There they succeeded in getting 17,500,000 eggs, and of that number we eyed 11,250,000, about 70 per cent. These eggs were treated exactly the same as the Saginaw Bay eggs and by the same crew, up to the time they were ready to transfer to the station. From the Bay City headquarters they were moved by wagon and rail to Detroit to the hatchery. From St. Clair river they were taken by row boat to the dock, and there put on the steamer for Detroit. Eggs were taken the same way and handled in a similar manner with the exception of the transportation, and in one case we got less than 10 per cent and in the other 70 per cent of eyed eggs.

Various ideas have been brought out as to how matters can be improved. I have suggested that we establish an eyeing station at Bay City, thinking possibly it might be an advantage. Some believe that the Saginaw Bay water is detrimental. Mr. Downing I think is of that opinion. The water in the St. Clair river is of course very much clearer than it is in Saginaw Bay. The probabilities, however, are that before we establish an eyeing station on Saginaw Bay, I shall ask the commissioner to send a scientist to that point when we establish the field station next spring, to see if we are actually getting eggs that are all right.

First we must see if it is the eggs that are not right, or the milt that is not right, or the water that is used. This low percentage of eyed eggs must be increased. That there is no use of the Bureau taking large quantities of eggs and only getting 10 or 12 per cent of them eyed is evident. We hope to do something to better conditions, and I think that probably the first thing to do is to look into the matter thoroughly with the aid of our

scientific friends. If it is found that we are getting good eggs and the loss is subsequent, an eyeing station must be established near the place of taking. There will be no dearth in the supply, for there are billions of eggs in Saginaw Bay.

Mr. Fullerton: How would you eye the eggs at that station?

Mr. Clark: Mr. Downing's experience is practically ours. At first they appear to be the nicest looking eggs you ever saw; but shortly after that you have the worst mess imaginable; and still 50 or 60 per cent of them will be eyed.

Mr. Fullerton: You will have to get a battery of jars on your fishing grounds at Saginaw Bay.

Mr. Clark: We would simply put up a hatchery, that is all; not temporary, but rather a cheap affair. I have some plans prepared that have not yet been submitted to the office.

Mr. Fullerton: Then you would not hatch them out right there?

Mr. Clark: No, only what are to be planted right there in Saginaw Bay. If we should take large numbers of eggs we could plant some of the fry back in the bay at that point and simply eye and send the remainder to the hatching stations. One of our arrangements with the Michigan Fish Commission was to annually turn over 50,000,000 eyed eggs, which we nearly accomplished this year.

Mr. Fullerton: We are interested in the pike-perch in Minnesota; and our methods are somewhat like those described in the paper read; but we are always very careful, and it pays to have lots of tubs. We use the corn starch very freely and keep a man continually washing them out; and we find the more they are washed with that corn starch water, fresh water being added to the corn starch, pouring that off and washing the eggs again, and keeping them in motion, the better results we have. In fact we have hardened them in sample tubs, then placed them in marked jars, and hatched over 90 per cent. Only one female was used, a medium sized fish, and the eggs would be all like shot, never stuck together, no fungus in the jar; and I think it would pay each state to give more attention to that particular point. But it will require more work and more men.

It will pay in the long run to give attention to the eggs in the washing, and the corn starch, so that they wont stick together, and harden them in tubs. We find careful attention paid to the eggs in the first place pays in the long run.

Mr. Meehan: What temperature did you have when you got 90 per cent?

Mr. Fullerton: Fifty-two degrees. This was only in the samples of the tubs that we took for experimental purposes. But we took particular care of them, and kept the tubs continually washed and in motion, and when they were finally put in the jar they were like shot, and never stuck together.

Mr. Clark: In the case of the eggs taken on the St. Clair river where it showed 70 per cent, there was no corn starch used whatever. In fact nothing was used.

Mr. Fullerton: I don't see how you got along.

Mr. Meehan: Nothing but the water?

Mr. Clark: Yes.

Mr. Downing: Along the lines of temperature I asked Mr. Buller, who had charge of the Erie station, to whom the eggs were shipped, and he hatched 80 per cent as against my 56 per cent, in regard to the water temperature, that is, about his water supply; and he said it was pumped about two and one-half miles to a reservoir, then let through pipes to the hatchery another two miles, and his water temperature was constant. But I believe that after segmentation has commenced and they are in the most tender stage, if the water temperature drops very low, it is very detrimental, if not fatal, to the eggs.

Mr. Clark: This is a vital subject. Speaking of handling the eggs as Mr. Fullerton does, I differ with him. I think the less they are handled and have them clean, the better. If the eggs could be taken and properly washed and hardened, without any stirring whatever to keep them free, it would be all the better, and I think Mr. Downing will agree with me.

Mr. Fullerton: You cannot do it.

Mr. Clark: I have a notion that the Saginaw Bay eggs were

perhaps hurt more in handling than in any other way. The St. Clair eggs not being handled so much, because the water was clearer, gave better results.

Mr. Fullerton: How can you handle the eggs without putting something on to take the stickiness off?

Mr. Clark: I think Mr. Downing will agree with me that millions of eggs have been hatched without the aid of anything further than water.

Mr. Downing: We bought eggs this year and paid for them by the quart; and they were taken by a man whom I have never seen, but he is one of the foremen for the firm that we bought our eggs from, and he did not use starch or anything, and on an average from beginning to end his eggs were the best that we had.

Mr. Fullerton: I am here to learn, but I am telling you the results that we have had.

Mr. Downing: There has been only one year before in my five years' work, while I have been in charge, that I have used anything.

Mr. Clark: I would like to ask Mr. Downing why he used starch this year, and if it was used on all the eggs?

Mr. Downing: The men that I sent out myself, I gave instruction to use starch on all of them.

Q. Why?

A. Because I was of the opinion that it was a good thing if properly used, and I impressed it on them to use it as nearly as possible according to orders, as the circumstances would allow.

Mr. Clark: Did you have any better results than you did the years you did not use starch?

A. I got one per cent better this year, but I am not certain whether it is due to the starch or the water.

Mr. Lydell: I would like to say a word in regard to the starch matter. I have had a lot of experience in securing wall-

eyed pike eggs for the Michigan Fish Commission. The reason we used the starch was, that Professor Reighard had demonstrated that the stirring of the eggs broke the yolk sac, and killed the eggs. We would take a female and strip her on the beach and fertilize the eggs, and in some cases 100 per cent were fertilized, but by putting them into a pail and stirring them he would examine them, and say there are only 30 per cent good; and the yolk sac burst in the shell. The last season I was on this work at Toledo I used the starch method to get rid of stirring the eggs; and the eggs were not stirred a particle. The method we used was nearly the same as Mr. Downing used, and we had about the same apparatus. The man had a big keg with a screen near the top, and a pail that would go into the keg and empty; then he had a small wooden chopping bowl that set on this pail, and his instructions from me were to take not more than one large or two small females, and give them plenty of milt and a little water, and they were tipped over into the pail. This pail had probably four or five inches of water. After repeating three or four times we lowered the pail into the keg, where we had put three or four gallons of water with a pound of starch; and these eggs were not disturbed at all after being put into the keg; they were simply dumped in. When he came to the end of the pound net string he turned the water on, as Mr. Downing did, inside the keg, and it ran out through the screen, and the starch washed off; he did this until we got there. Then the eggs in this keg were hustled on board the steamer and two of us took care of them until we got to Toledo. We had twelve men taking eggs. As quick as we got them on board the steamer we turned the hose on the eggs gently, played on one keg awhile and then another, until we got to Toledo; and no man's hand touched the eggs. When we got to Toledo we had an apparatus somewhat similar to the apparatus on these fish cars here, with the exception that water ran in, instead of air, and this was connected to each keg, and the water was turned on; then we went away to our dinner. When we got ready to ship they were taken from there and put in cans or boxes. In the first lot the first year that I was there we found a great many dead eggs, that we thought were injured by sudden jarrings. After that we used a spring wagon with plenty of straw in the bottom. The eggs were put aboard cars,

shipped to Detroit and handled in the same way, to the hatchery, and Mr. Bower will tell you the kind of eggs we got there. The last year I do not think there was ever a finer lot of eggs taken. We used the starch method to prevent stirring the egg.

Mr. Seymour Bower: I was in charge of the Detroit hatchery at that time, and personally supervised the handling of eggs after their receipt at the hatchery, and they were the finest lot of pike-perch eggs for a large lot that I ever saw anywhere. We had something over 70,000,000 eyed eggs from them; and the actual percentage of fish hatched was 56; they were carefully measured when received and carefully measured after being thoroughly cleaned up, and I know that the hatching percentage is accurate. They were handled in the jars substantially as Mr. Downing states.

I recall one lot in particular that we eyed, which was a little better, being 75 or 76 per cent.

Mr. Lydell: I also took eggs for a number of years on Saginaw Bay, but we could not get many of them fertilized. Mr. Marks and Professor Reighard were there for several seasons.

Mr. Clark: I would like to ask Mr. Lydell if Professor Reighard was at Saginaw Bay and made examination as to the fertilization of eggs?

Mr. Lydell: Yes, sir, two seasons.

Mr. Clark: That might solve the problem as to whether or not we are getting fertilized eggs in Saginaw Bay.

Mr. Lydell: I would bring a lot of live fish and fertilize them on the beach, and he would put them under his glasses and say, for instance, we had 90 per cent fertilized, but when we got them to the hatchery we could not hatch out more than 25 per cent, but the method used in taking the eggs was not the same as when I took charge of the work below.

The pike-perch, as you know, is very tender. If it comes in contact with anything it will burst the yolk sac; but we had orders at that time to take them that way, and the poor eggs shipped down from Saginaw Bay would fill this room.

Mr. Whish: Some of our men who have been looking into

this have noticed that there are certain seasons when the eggs do not turn out well, and they figure that it is the season following an unusually severe winter.

Mr. Clark: That would not explain why during the same year we get a hatch of 70 per cent from eggs taken from the St. Clair river, and 10 per cent from eggs taken from Saginaw Bay.

Mr. Whish: When they had an unusually severe winter on Oneida Lake, 50 per cent hatched; last year when it was warmer they got 90 per cent.

Mr. Fullerton: I would like to ask Mr. Lydell if his idea in using the corn starch was because he did not want to stir the eggs?

Mr. Lydell: Yes.

Mr. Fullerton: You say you pour the corn starch into the pail?

Mr. Lydell: We put corn starch in the keg with plenty of water, and when the eggs settled the corn starch settled with them, and got between the eggs, and kept them from adhering.

Mr. Fullerton: There is nothing in the world worse than corn starch to settle at the bottom and get into a hard cake; and it is worse than sand. It is like white lead after white lead settles, and I do not see how you can use it except you keep it stirred all the time and wash it off.

Mr. Lydell: Undoubtedly you use too much corn starch.

Mr. Fullerton: We use a pound package to a gallon of water, stir it thoroughly and put it in a tub holding about thirty gallons. We dip it out with a dipper. We never allow any one's hand to touch the eggs. The water is poured in with a dipper.

Mr. Seymour Bowers: I am strongly inclined to think that temperature has a great deal to do with the quality of the eggs. A peculiar thing about the spawning season in Saginaw Bay is, that during the season we operated there we found that we would get mature fish just as soon as the ice went out, while the water was pretty close to a freezing temperature.

Mr. Clark: The temperature was 35 degrees to 39 degrees.

Mr. Bower: And in the St. Clair river they did not begin to spawn until over a month later. I have known pike-perch eggs to be taken there as late as the 5th or 7th of June. They are all through spawning by the 5th of May in Saginaw Bay. We always get a very much higher percentage of fertilization in St. Clair river than in Saginaw Bay or anywhere else, as far as I know.

In regard to the effect of low temperature on eggs, I remember in 1893 we were conducting experiments as to retarding the development of eggs so as to make a shipment, if possible, for the World's Fair in Chicago. We lowered the temperature with ice, and while I am not absolutely certain as to the temperature, but my memory is that we reduced it to 38 degrees. I am speaking now of the green eggs; and it was fatal to nearly all of them. They did not survive a temperature of 38 degrees. We made a number of experiments and found that we could not successfully retard them; and I do not believe you can successfully retard the development of any fish eggs very much below the normal. I think it is very injurious at least to have the development of the eggs arrested. I believe that is one of the causes of the poor eggs that were taken under Mr. Clark's supervision last spring. I was at the hatchery frequently when the eggs were received, when different lots of eggs came in while the water temperature was 45 degrees, later falling to 39 degrees, and hovering about there for several days. I do not believe when the development has started that it can be arrested for any length of time without more or less injury. It must go forward at a greater or less rate, and when you arrest the development or check it entirely, as must have been the case, or nearly so at least, when the temperature dropped from 45 to 39 degrees, I believe it killed a good share of the eggs.

Mr. Lydell: What percentage did Mr. Fullerton get in his hatching?

Mr. Fullerton: We had 90 per cent hatched in the sample, roughly. We had 49 per cent in the general hatching.

Mr. Lydell That is a big percentage.

Mr. Clark: Were not those eggs from one fish?

Mr. Fullerton: No, they were from three fish. One was a good sized fish and the other two small.

Mr. Lydell: A man can select one or two females and males and perhaps hatch 95 per cent of a quart of eggs; but in taking a big lot of eggs, the biggest I ever had was on the St. Clair river, which was 75 per cent.

Mr. Clark: I am of the opinion that in special cases, with special fish or something of the kind, it is possible to do what Mr. Fullerton has done, and perhaps it might be raised to 100 per cent.

I do not think that the attention is what gave Mr. Fullerton 95 per cent. It was a special lot of special fish sorted out for that purpose.

Mr. Fullerton: I will make an experiment on a larger scale, and I think the results will be the same with the same care.

Mr. Downing: Almost every year I have a few individual jars that turn out anywhere from 50 to 80 or 85 per cent, and they are of good quality; and I cannot account for it except that it happens so.

REMARKS ON SPONGE CULTIVATION.

BY DR. H. M. SMITH.

Perhaps you are not averse to turning your attention for a moment from fishes to the long suffering and humble sponge. All the gentlemen present may not be aware that for a number of years we have been growing sponges from clippings at several farms on the Florida coast. Those who care to pursue the subject further are referred to the paper by Dr. H. F. Moore on "Progress of Experiments in Sponge Culture" which appeared in the proceedings of the society for last year (page 231). Dr. Moore has been in charge of those experiments and I want to exhibit some speciments which he brought up from the farm near Anclote Key, on the west coast of Florida this spring.

The sponges are grown, as I have said, from cuttings, the cuttings being about a cubic inch in volume; and the advantage of this method is that irregular sponges having little market value, can be planted and will grow into perfectly symmetrical sponges of better quality than wild sponges grown on the same ground, for reasons that have been explained before.

I exhibit a string of sponges three years old, having a value today of $3.50 a pound. If left on the ground another year they would be worth $4.50 to $5.00 per pound, about twelve sponges to the pound. Gentlemen who are interested are requested to feel these sponges, more especially the moist ones, and see what excellent quality they represent.

DISCUSSION.

Mr. Clark: I would like to ask Dr. Smith a question: Do sponges of any form grow in fresh water?

Dr. Smith: Yes, sir, but they are of no commercial value, only as biological curiosities.

Mr. Clark: There was brought into my office this spring a small piece of sponge, as I called it, taken off the stones in a bass pond.

Dr. Smith: They are usually of very small size.

FROG CULTURE.

BY W. E. MEEHAN, COMMISSIONER OF FISHERIES.

In May, 1904, a four-line item sent out by the Associated Press appeared in the Pennsylvania newspapers, announcing that the Department of Fisheries would receive applications for frogs or tadpoles for public planting. In anticipation of this announcement the Department of Fisheries had prepared about 1,000 blank application forms. To the astonishment of the Department the 1,000 blank application forms were taken up within ten days and it is safe to say that nearly 1,000 letters in addition were received, asking to be supplied with frogs for stocking purposes. Editorials appeared in the majority of the country papers and even in the metropolitan daily papers calling attention to what they termed an admirable effort on the part of the Department of Fisheries to rear frogs. To my surprise and pleasure hundreds of letters poured in commending this branch of the work and before long the news of Pennsylvania going into the work of frog culture extended beyond the state and letters of inquiry came from many state fish commissioners and from magazines devoted to fish cultural work.

I had always regarded it as important that frog culture should be undertaken because I saw that an important industry could be developed. Almost immediately upon assuming my duties as Commissioner of Fisheries I directed the various superintendents to experiment with a view of successfully raising frogs. My wishes in this particular were well known not only in Pennsylvania, but elsewhere, consequently when the public announcement was made that applications for frogs would be received and filled it was naturally supposed that success had followed the experiments. This, however, was not the fact, although one of the superintendents, Mr. William Buller of the Corry Hatchery, was on the eve of what now appears to be a complete success. The tadpoles and young frogs distributed in 1904 under the calls were raised from wild spawn, gathered in the marshes on Lake Erie by Mr. A. G. Buller, superintendent of the Erie Hatchery.

The work of Mr. A. G. Buller nevertheless was exceedingly interesting. The spawn was in various stages of development, from green to nearly hatching. Indeed much of the spawn was so far advanced that hatching took place on the way from the marsh to the hatchery ponds at Erie.

The eggs were placed in a small pond, the water of which was from 57 to 60 degrees and the period of complete incubation was in about twelve days.

Almost immediately on hatching the little creatures clung closely to the gelatenous mass from which they emerged and began to eat it and they never left until it was entirely gone. Then they spread over the pond hunting for food. There were rather more than 30,000. They soon cleaned up every particle of food which was in the pond and Mr. A. G. Buller then supplied them with dead fish, and so great was their voracity that they easily devoured from 16 to 25 pounds of fish a week. On one occasion they completely stripped a 16-pound carp in four days.

The temperature of the water rose a little above 60 degrees and in this the tadpoles grew very fast and in about two and one-half months from the date of their hatching began to develop their hind legs. Three weeks later they broke forth their fore legs and the outline of the body and head began changing to that of a frog. The tail also began to be "absorbed." The moment the hind legs appeared and before the tail was absorbed and before the body completely changed to frog outlines the creature ceased to feed on dead food. For a few days they seemed to refuse any kind of food, but before the tail was half absorbed they began to take live creatures only. They confined themselves almost exclusively to insects and spiders. As illustrating the extreme voracity of tadpoles and the eagerness with which they would take dead food was markedly shown on one occasion at the Wayne County Hatchery this spring. A black-bass weighing about four pounds and extremely maloderous, having been dead several days, was thrown into a portion of the pond in which for the moment there were no tadpoles. Within two minutes at least 200 tadpoles nearest to the fish, began a number of curious evolutions. They rolled and tumbled over each other in thick masses until they formed almost a ball and

in this manner they rolled and tumbled and swayed rapidly toward the dead fish on which they fastened themselves at once. The tadpoles even at the extreme end of the pond some twenty feet away seemed to be cognizant of the presence of the food, and large numbers of them made their way in the same strange evolutions to the tidbit and settled themselves so thickly thereon that within five minutes it was impossible to see anything but a mass of tadpoles outlined like a fish. They stripped every particle of flesh from the dead bass within an hour.

Returning to the tadpoles hatched in 1904, by the first of August there was not one in the Erie ponds, but had changed entirely into a perfect frog. Shipping began in July. Three hundred and fifty were sent on each application and they were sent in tadpole form with the cans about half filled with water. The first shipment of tadpoles having legs were made in the same manner, namely in water, but it was found that they did not carry well, and the frogs, it was learned, carried best when placed in damp glass. It was unnecessary to send any messenger along with either the tadpoles or frogs, excepting where more than one railroad transfer had to be made. Nothing could be done as far as known, to benefit them by sending messengers, and no aeration is necessary because the higher the temperature the better the tadpoles would probably like it.

This year two ponds at the Erie hatchery were set aside for hatching wild spawn and about 60,000 were hatched in each pond. Owing to weather conditions the water was much colder than last year and the hatching period was from 15 to 18 days. The tadpoles were much smaller than those hatched last year, probably on account of the cold water. They appeared, however, to be as healthy and active. They remained in this condition for about five weeks, when suddenly the tadpoles in one of the ponds sickened and died. Thirty thousand died in one night. The rest were hurriedly planted in the marshes at Erie the following day, some dying on the way. The tadpoles in the other ponds remained apparently all right for about ten days, when they too died, the whole pond becoming empty of live tadpoles within thirty-six hours. An examination showed that on the stomachs of each tadpole was a round red spot. Unfortunately no microscopic examination was made and no specimens were

sent to my office for examination owing to my absence from Harrisburg. The tadpoles at the Wayne Hatchery, several hundred thousand in number, showed no signs of disease and are now being shipped to applicants.

The experimental work in frog culture at the Corry Hatchery was exceedingly interesting. Mr. William Buller constructed a little pond which he concluded the frogs would naturally take to. Two hundred large frogs were brought from Lake Erie and placed therein. Within twenty-four hours they had all climbed the fence which surrounded the pond and departed to a nearby woods where they have since increased and multiplied marvelously. Last year he remodeled the pond, changing the form of the fence in such a manner that the frogs could not escape. More than 200 large frogs were placed within the inclosure and all lived through the winter and spawned this spring. They yielded about 10,000 tadpoles and at the time of writing this paper they are still within the inclosure and apparently perfectly healthy and contented. As it is well known that frogs will eat nothing but live food the real problem was to supply a large number in a small space and this was done by placing boards both on the wet grass outside the water limit and by anchoring others on the surface of the pond. On these boards were smeared molasses and honey. Bees and other insects were attracted in large quantities and the frogs fattened. The same method of feeding is now pursued. Both old and young frogs and tadpoles refuse maggots.

The pond proper is about 20 feet long with a deep bottom of soft muck. During the winter months at the breast of the pond the water was about four feet deep and kept so until winter passed entirely away, when the supply of water was reduced to about a foot at the breast and only a few inches at the upper end. The bed of the pond sloped upward from the breast until only there was about a few inches from the foot of the mucky bed to the surface of the ground and this was occasionally flooded with water and the grass allowed to grow, grass being not only hiding places for the frogs, but also serving to attract insects. The fence was placed about four feet from the edge of the pond. Fitting close to the ground was placed a 12-inch board on edge on all four sides of the pond and a 30-inch mosquito bar was

tacked on the inner side of the board so that there was a fence 42 inches high. Posts were placed every six feet. On the top of the fence was carefully fastened a piece of muslin 12 inches wide and extending at right angles with the fence. It was found necessary to place this muslin there because otherwise the frogs would clamber up the wire screen and escape over the top, but by tacking the muslin on they found a space or ceiling which balked them. Great care must be exercised that the muslin fits tight to the top of the fence, otherwise the frogs will raise the muslin and escape under it, just as a boy would crawl under a canvass of a circus tent. In fact, at Lake Erie, although the superintendent thought he had everything secure more than 200 managed to escape in one night by creeping under the muslin. These escaping frogs by the way invaded the neighboring yards and houses to the discomfort and alarm of the feminine occupants. At the Torresdale Hatchery a 12-inch planed board is substituted for the muslin and gives greater satisfaction.

In caring for frogs, especially in the tadpole stage it is necessary to guard very carefully against the ravages of snakes. These reptiles before they were discovered devoured fully 100,000 tadpoles at the Corry Hatchery and accomplished this feat in less than three weeks. I have given above the results of Pennsylvania's work thus far in frog culture. It has reason to be encouraged in the belief as a result it has demonstrated that a large number of frogs can be cared for in a very limited space and that with ordinary precaution and the expenditure of individual energy a very large and valuable industry can be built up in the United States.

DISCUSSION.

At the conclusion of his paper Mr. Meehan said: "There are one or two things that I would like to add which have occurred since the writing of this paper some six or seven weeks ago. I have stated in here that apparently the snakes were the cause of the loss of all frogs in the Corry hatchery. While that may still be the case to a considerable extent, I have reason to believe that there was another cause, and perhaps one that was even of more importance than the snakes, and that is the frogs themselves. Now since writing this paper Mr. Nathan R. Buller, the

superintendent of the Wayne County hatchery, discovered that the frogs were very fond of the tadpoles and devoured them very eagerly; so it is quite possible that the frogs themselves were partly responsible for this destruction of many of the frogs in Corry pond. It therefore follows that when we carry on frog culture it will be necessary to have an additional pond to the one in which the frogs are kept; that either the spawn must be taken out and hatched elsewhere, or the tadpoles and the frogs must be separated.

We find also some other enemies among birds. Not only the ordinary preditory birds, but the crows have developed great fondness for tadpoles, and Mr. Buller had quite a time with them for several days, until he managed to keep them off by scarecrows.

It is needless to say that, considering the general excitement in regard to putting forth frogs by Pennsylvania, and in ending what I have got to say here, perhaps it might not be uninteresting to read you a short clipping coming from a little paper in Hanover, Pennsylvania, which shows that even we ourselves who hatch fish and frogs do not know everything. This little item is entitled, "Pretty Little Frogs," and is as follows:

FOUR THOUSAND HOPPERS RECEIVED BY HANOVER PARTIES.

Messrs. S. W. Yingling, of Hotel Hanover, and H. M. Stokes, of York St., have received from the State Fish Hatchery at Pleasant Mount, Wayne County, a consignment of 2000 young bullfrogs, in two cans, each can containing 1000 frogs. Two additional cans were received by parties residing in the country near Hanover.

The frogs are sent out by the State Fish Commission for propagation in the streams of this vicinity. Mr. Yingling took his brood to Waldheim Wednesday, and released them in the Conewago Creek.

The bullfrogs in this shipment are of a different species from that known in this section. Each frog is about one-fourth of an inch long, and perfectly formed like a full-grown frog, only much smaller. They are of French origin, and do not pass through the tadpole or "mullygrub" evolution. They are dainty little creatures in their present state, but appear lively and are ready to hop or swim whenever given a chance.

Dr. Gorham: In regard to the disease which Mr. Meeham spoke of as killing so many of his frogs, it is undoubtedly a very well-known disease which occurs among frogs whenever considerable numbers are kept in confinement. I have had cases of that disease among frogs that I have kept for some time. I might say also, that a very careful study of the disease, from all standpoints, has been made and published within the past year, by Mr. H. Emerson and Mr. Charles Norris, in the Journal of Experimental Medicine, New York, 1905, VII, 32, the subject of the article being "'Red-leg,'" an Infectious Disease of Frogs." The article is a complete one, and describes the disease very carefully, and suggests remedies and methods of prevention.

Mr. Meehan: Can you recall one of those remedies?

A. I don't remember the remedies.

Q. Is it an infusorial trouble?

A. A bacterial disease.

Mr. Titcomb: In what stage of development do you make your distribution?

Mr. Meehan: At first we distributed in tadpole form, but we abandoned that and we now distribute in frog form only. The tail may still be there, but the legs may also be present and the frogs have abandoned the water altogether, and use only the wet moss.

In shipping, I ought to add, that it is very necessary if you use the cans the same as we do, that is, with a single round hole in the top, to put over the top of the can a piece of mosquito netting, or the frogs will crawl out.

Mr. Nathan R. Buller: All of the reports have been very favorable in regard to the successful shipment of frogs.

Mr. Dinsmore: I remember reading some years ago quite a lengthy description on frog culture, in which the conclusion reached was, that there was no trouble in rearing the tadpoles in unlimited numbers, but you could not supply food for the frogs. Now why can you not supply the frogs with the superfluous number of tadpoles, if, as the writer says, you can get the tadpoles in unlimited numbers?

Mr. Meehan: I have not had an opportunity to talk with Mr. Buller much about that. He reported to me that he found frogs eating the tadpoles. He can tell you to what extent they did it.

Mr. Densmore: Do you use any particular species of frogs?

Mr. N. R. Buller: At Erie we use the great western frog, the large frog; at Wayne the green frog; at Corry the western frog altogether.

Mr. Dinsmore: What was the actual size of the frogs that you shipped?

Mr. Buller: About an inch and a half long.

Mr. Lydell: At what time does the tadpole shed his tail? I have collected large tadpoles to feed as food to the bass. They are just now commencing to form legs. We have seined them up there in ten or fifteen quart pails full, to feed the bass. I took it for granted that these frogs were from the spawn of the frog last year, because the big green bullfrogs are now spawning.

Mr. Meehan: Apparently there are two periods of spawning. We have frogs spawning early in the season and they are spawning again. We find them preparing to spawn in the Wayne ponds.

The period of changing from tadpole to frog form will vary considerably according to the temperature of the water. It is a curious fact that several years ago, five or six, or perhaps more, Mr. William Buller raised a large number of tadpoles at Corry; and he carried them through to this spring in tadpole form, and they were in spring water at a temperature of 50 degrees. They retained the tadpole form throughout the winter and did not change to the frog form until the spring, that is, until one year had elapsed. On the other hand we have hatched them out and in about thirty days we have the full tadpole of the same species.

Mr. Lydell: Then I think ours the two-year variety.

Mr. Meehan: These frogs you see here were this spring's spawning.

Dr. Gorham: In New England all our frogs have one spawning season.

LIST OF MEMBERS.

ACTIVE.

Adams, E. W., *114 Wall Street, New York.*
Adams, Fred J., *Grand Rapids, Mich.*
Ainsworth, C. E., *Sault St. Marie, Mich.*
Ainsworth, G. G., *United States Bureau of Fisheries, Leadville, Col.*
Allen, A. D., *Superintendent Wallowa Hatchery, Elgin, Ore.*
Allen, G. R., *Roxbury, Vt.*
Alexander, A. B., *United States Bureau of Fisheries, Washington, D. C.*
Alexander, George L., *Grayling, Mich.*
Alexander, L. D., *50 Broadway, New York.*
Anderson, J. F., *Djursholm, Sweden.*
American Fish Culture Co., *Carolina, R. I.*
Andrews, Barschall, *Columbus, Ga.*
Annin, James, Jr., *Caledonia, N. Y.*
Ashford, W. T., *711 Prudential Building, Atlanta, Ga.*
Atkins, Charles G., *East Orland, Me.*
Atwood, Anthony, *73 Waterest Street, Plymouth, Mass.*
Ayer, F. W., *Bangor, Me.*

Babbitt, A. C., *Williamsburg, Mich.*
Babcock, John P., *Fisheries Commissioner, Victoria, British Columbia, Can.*
Bailey, Nelson, *Wells River, Vt.*
Baldwin, O. N., *United States Bureau of Fisheries, San Marcos, Tex.*
Ball, E. M., *Leadville, Col.*
Barbour, Thomas, *Museum of Comparative Zoology, Cambridge, Mass.*
Barrett, W. W., *Church's Ferry, N. Dak.*
Bartlett, Dr. S. P., *Quincy, Ill.*
Bastedo, S. T., *Toronto, Can.*

Beaman, D. C., *Boston Building, Denver, Col.*
Beeman, Henry W., *New Preston, Conn.*
Bean, Barton A., *United States National Museum, Washington, D. C.*
Bean, Hon. Tarleton H., *Battery Park Museum, New York City.*
Beardsley, A. E., *Greeley, Col.*
Beeson, W. E., *care of Foster, Stevens & Co., Grand Rapids, Mich.*
Beasom, W. H., *Treasurer Nashua Saddlery Hardware Co., Nashua, N. H.*
Bell, Currie G., *Bayfield, Wis.*
Belmont, Hon. Perry, *580 Fifth Avenue, New York City.*
Bennett, Charles P., *Secretary of State, Providence, R. I.*
Bennett, Charles, *Woonsocket, R. I.*
Bentley, B. C., *Westerly, R. I.*
Benton, Judge Henry T., *Seale, Ala.*
Bickmore, Prof. A. S., *American Museum of Natural History, New York City.*
Birge, Prof. E. A., *Madison, Wis.*
Bissell, John H., *Detroit, Mich.*
Blakeslee, T. J., *353 Fifth Avenue, New York City.*
Boardman, W. H., *Central Falls, R. I.*
Bogle, C. M., *Editor Pacific Fisherman, Seattle, Wash.*
Booth, DeWitt C., *Spearfish, S. Dak.*
Bottemanne, C. J., *Bergen op Zoom, Holland.*
Bowdre, N. H., *Plummerville, Ark.*
Bower, Seymour, *Detroit, Mich.*
Bower, Ward T., *United States Bureau of Fisheries, Northville, Mich.*
Bowers, Hon. George M., *United States Bureau of Fisheries, Washington, D. C.*
Bowman, W. H., *Rochester, N. Y.*
Bowman, W. F., *Breakwater Hotel, Woods Hole, Mass.*
Boyce, F. C., *Elko, Nev.*
Brewster, C. E., *Grand Rapids, Mich.*
Brewster, W. K., *Durand, Mich.*
Britton, F. H., *Vice President and General Manager St. Louis Southwestern Railroad, St. Louis, Mo.*
Brass, John L., *Mill Creek, Mich.*

Brewer, E. S., *Owosso, Mich.*
Brower, J. F., *Torrisdale Hatchery, Holmesburg, Pa.*
Brown, George H., Jr., *Money Order Division, Post Office, Boston, Mass.*
Brown, George M., *Saginaw, Mich.*
Brown, G. W. N., *Erwin, Tenn.*
Brown, Thomas, *Salmon, Ore.*
Brush, Dr. E. F., *Mount Vernon, N. Y.*
Buck, William O., *East Orland, Me.*
Bulkley, H. S., *Odessa, N. Y.*
Bullard, C. G., *Kalamazoo, Mich.*
Buller, A. G., *Erie, Pa.*
Buller, Howard M., *Bellefonte, Pa.*
Buller, Nathan R., *Pleasant Mount, Pa.*
Buller, William, *Corry, Pa.*
Bumpus, Dr. H. C., *American Museum of Natural History, 77th and 8th Avenue, New York City.*
Burner, W. G., *Durbin, W. Va.*
Burnham, E. K., *United States Bureau of Fisheries, Washington, D. C.*
Bush, C. P., *Columbus, Ga.*
Butler, H. A., *Mauch Chunk, Pa.*

Campbell, S. H., *State Fish Commission, Laramie, Wyo.*
Carter, E. N., *United States Bureau of Fisheries, St. Johnsbury, Vt.*
Casselman, E. S., *Dorset, Vt.*
Chamberlin, F. M., *United States Bureau of Fisheries, Washington, D. C.*
Champlin, John H., *Westerly, R. I.*
Chase, H. C., *1020 Arch Street, Philadelphia, Pa.*
Chandler, Horatio, *Kingston, Mass.*
Cheney, Major Richard O., *South Manchester, Conn.*
Clark, C. C., *306 East South Street, South Bend, Ind.*
Clark, Charles G., *General Treasurer's Office, Providence, R. I.*
Clark, Frank N., *Northville, Mich.*
Clark, Fred, *Mill Creek, Mich.*
Clark, Walton F., *Westerly, R. I.*
Cobb, E. W., *St. Johnsbury, Vt.*

Capehart, Dr. W. R., *Avoca, N. C.*
Cobb, John N., *United States Bureau of Fisheries, Washington, D. C.*
Cogswell, T. M., *United States Bureau of Fisheries, Washington, D. C.*
Cohen, N. H., *Urbana, Ill.*
Coker, Robert E., *Johns Hopkins University, Baltimore, Md.*
Cole, Leon J., *37 Mellen Street, Cambridge, Mass.*
Collins, Hon. J. C., *Providence, R. I.*
Comee, J. F., *care of P. C. R. R., San Louis Obispo, Cal.*
Cone, Moses H., *Flat Top Manor, Bowling Rock, N. C.*
Cooper, E. A., *Cold Spring Harbor, L. I.*
Corliss, C. G., *Gloucester, Mass.*
Coulter, A. L., *Charlevoix, Mich.*
Cox, Hon. Henry C., *Wellsboro, Pa.*
Cranson, S. E., *Northville, Mich.*
Crosby, H. F., *41 Wall Street, New York City.*
Cruickshank, James, *217 Central Park, West, New York City.*
Cunningham, F. W., *Gloucester, Mass.*
Curry, W. F., *Freeland, Pa.*
Curtis, J. M., *Cleveland, O.*

Dale, J. A., *York, Pa.*
Davis, E. A., *Bethel, Vt.*
Davis, Hon. George B., *Utica, Mich.*
Davis, B. H., *Palmyra, N. Y.*
Dean, Herbert D., *United States Bureau of Fisheries, Neosho, Mo.*
DeCarlo, G. Postiglione, *Naples, Italy.*
Degler, F. A., *Sportsman's Association of Cheat Mountain, Cheat Bridge, W. Va.*
Demuth, H. C., *144 King Street, Lancaster, Pa.*
Dennis, Oregon, Milton, *Secretary Maryland State Game and Fish Protective Association, Baltimore, Md.*
DeNyse, Washington J., *Gravesend Beach, Borough of Brooklyn, N. Y.*
De Puy, Henry F., *296 West End Avenue, New York City.*
De Rocher, James D., *Nashua, N. H.*
Dickerson, Freeman B., *Detroit, Mich.*

Dinsmore, A. H., *East Orland, Me.*
Donahue, L. H., *United States Bureau of Fisheries, Leadville, Col.*
Douredoure, B. L., *103 Walnut Street, Philadelphia, Pa.*
Douglas, W. B., *St. Paul, Minn.*
Downing, S. W., *Put-in-Bay, O.*
Doyle, E. P., *Port Richmond, N. Y.*
Dunlap, I. H., *United States Bureau of Fisheries, Washington, D. C.*

Ebell, Hon. F. W., *Harrisburg, Pa.*
Edwards, Vinal N., *Woods Hole, Mass.*
Ellis, J. Frank, *United States Bureau of Fisheries, Washington, D. C.*
Evans, Barton D., *Harrisburg, Pa.*
Evarding & Farrell, Messrs., *Portland, Ore.*
Evermann, Prof. Barton W., *United States Bureau of Fisheries, Washington, D. C.*
Everman, J. W., *Assistant General Manager Texas & Pacific Railroad, Dallas, Tex.*

Fassett, H. C., *United States Bureau of Fisheries, Washington, D. C.*
Fearing, Hon. D. B., *Newport, R. I.*
Ferry, C. H., *Room 1720, Old Colony Building, Chicago, Ill.*
Filkins, B. G., *Northville, Mich.*
Finch, George C., *Thompsonville, Conn.*
Fisher, John F., *Chapinville, Conn.*
Follett, Richard E., *Auditorium Hotel, Chicago, Ill.*
Fox, Captain J. C., *Put-in-Bay, O.*
Frook, John E., *Paris, Mich.*
Fudge, Andrew, *Covington, Va.*
Fullerton, Samuel F., *St. Paul, Minn.*

Gardener, W. E., *Hollidaysburg, Pa.*
Gavitt, W. S., *Lyons, N. Y.*
Gebhardt, A. E., *Secretary Oregon Fish and Game Association, Box 927, Portland, Ore.*
Geer, Dr. E. F., *St. Paul, Minn.*

Geer, E. H., *Hadlyme, Conn.*
George, Hon. A. F., *Swanton, Md.*
Gibbs, Charles, *East Orland, Me.*
Gifford, Franklin L., *Woods Hole, Mass.*
Gill, Dr. Theodore, *Smithsonian Institution, Washington, D. C.*
Gilmore, Charles C., *Swanton, Vt.*
Goldsborough, E. L., *United States Bureau of Fisheries, Washington, D. C.*
Gordon, Jack, *Paris, Tex.*
Gould, C. B., *83 Moss Avenue, Oakland, Cal.*
Graham, A. R., *Berkeley, Mass.*
Grant, R. P., *Treasurer Anglers' Association of St. Lawrence River, Clayton, N. Y.*
Grave, Dr. Caswell, *Johns Hopkins University, Baltimore, Md.*
Gray, George M., *Woods Hole, Mass.*
Green, Chester K., *Fisheries Station, Monument Lot, Washington, D. C.*
Green, Dr. D. W., *Ohio Fish and Game Commission, Dayton, O.*
Greene, Myron, *Franklin, Vt.*
Grindle, C. S., *United States Bureau of Fisheries, East Orland. Me.*
Guard, J. E., *Bullochville, Ga.*
Gunckel, John E., *Toledo, O.*

Haas, William, *Corry, Pa.*
Hagert, Edwin, *32 N. Sixth Street, Philadelphia, Pa.*
Hahn, Captain E. E., *Bureau of Fisheries Station, Boothbay Harbor, Me.*
Haley, Caleb, *Fulton Market, New York.*
Hall, C. E., *Superintendent Parkside Hatchery, Cresco, Pa.*
Hamilton, Robert, *Greenwich, N. Y.*
Hampton, F. F., *Hill City, Tenn.*
Handy, L. B., *South Wareham, Mass.*
Hansen, G., *Osceola, Wis.*
Harron, L. G., *United States Bureau of Fisheries, Washington, D. C.*
Hartley, R. M., *627 Walnut Street, Philadelphia, Pa.*
Hay, Prof. W. P., *Howard University, Washington, D. C.*
Hayes, J. R., Esq., *Detroit, Mich.*

Hamberger, Hon. John, *Erie, Pa.*
Helmer, D. S., *Post Allegheny, Pa.*
Helmer, E. R., *Post Allegheny, Pa.*
Hempshill, T. J., *Hollidaysburg, Pa.*
Henkel, C. D., *United States Bureau of Fisheries, Tupelo, Miss.*
Henkel, C. P., *Tupelo, Miss.*
Henry, W. S. *Parkside, Pa.*
Henshall, Dr. James A., *Bozeman, Mont.*
Hill, J. H., *Superintendent Umpqua Hatchery, Hoaglin, Douglas County, Ore.*
Hill, John L., *115 Broadway, New York City.*
Hines, W. B., *White Sulphur Springs, W. Va.*
Hobart, T. D., *Pampa, Gray County, Texas.*
Hogan, J. J., *La Crosse, Wis.*
Hogue, William F., *Marion, Ala.*
Holden, H. S., *Syracuse, N. Y.*
Hughes, Frank L., *Ashland, N. H.*
Hoxsie, Charles A., *Carolina, R. I.*
Howell, John H., *P. O. Box 485, New Bern, N. C.*
Hubbard, Waldo F., *Nashua, N. H.*
Hudson, H. T., *110 Third Street, Portland, Ore.*
Hume, R. D., *421 Market Street, San Francisco, Cal.*
Hunsaker, W. J., *Detroit, Mich.*
Huntoon, B. W., *care of Huntoon Oyster Co., Fairhaven, Wash.*
Huntington, L. D., *New Rochelle, N. Y.*
Hurlbut, H. F., *East Freetown, Mass.*
Hutchinson, E. S., *1331 G Street, Washington, D. C.*

Ingraham, E. W., *Oil City, Pa.*
Irish, Clifford E., *Lake George, N. Y.*
Isaac, George H., *United States Bureau of Fisheries, Spearfish, S. Dak.*

Jansen, Peter, *Escanaba, Mich.*
Jennings, G. E., *Fishing Gazette, 203 Broadway, New York City.*
Jewett, Stephen S., *614 Main Street, Laconia, N. H.*
Johnson, D. W., *Hartwell, Ga.*
Johnson, F. M., M.D., *43 Tremont Street, Boston, Mass.*
Johnson, O. J., *Glenwood, Minn.*

Johnson, R. S., *Supt. Manchester Station, Manchester, Ia.*
Johnson, George H., *Riverside, R. I.*
Johnson, S. M., *Union Wharf, Boston, Mass.*
Jones, Alexander, *United States Bureau of Fisheries, Fishery, Tenn.*
Jones, Col. James E., *New York City.*
Jones, Dr. O. L., *116 West Seventy-second Street, New York.*
Joseph, D., *Columbus, Ga.*
Joslyn, Hon. C. D., *Detroit, Mich.*

Kashiwa, A. M., *Pacific Block, Seattle, Wash.*
Kauffmann, S. H., *Evening Star, Washington, D. C.*
Keeseeker, A. G., *Fishery, Tenn.*
Keller, H. N., *California Fish Commission, Santa Monica, Cal.*
Kelly, H. L., Jr., *Oregon City, Ore.*
Kennedy, Edwin M., *Ohio Fish and Game Commission, McConnellsville, O.*
Kendall, Dr. William C., *United State Bureau of Fisheries, Washington, D. C.*
Kent, Edwin C., *Tuxedo Club, Tuxedo, N. Y.*
Kenyon, A. W., *Usquepaugh, R. I.*
Kiel, W. M., *Tuxedo Park, N. Y.*
Kisterbrock, Josiah, Jr., *"The Continental," Philadelphia, Pa.*
Kittredge, Benjamin R., *Kent Cliffs, Putnam County, N. Y.*
Knight, Prof. A. P., *Queens University, Kingston, Can.*

Lambert, E. C., *Amoskeag Mfg. Co., Manchester, N. H.*
Lambson, G. H., *United States Bureau of Fisheries, Baird, Cal.*
Lamkin, J. Bayard, *605 Massachusetts Avenue, N. W., Washington, D. C.*
Lamprey, Judge Uri L., *St. Paul, Minn.*
Landers, E. T., *Hopeville, Ga.*
Lane, George F., *Silver Lake, Mass.*
Latchford, Hon. F. R., *Toronto, Can.*
Laumen, Felix, *San Marcos, Tex.*
Lawton, Herbert, *Quincy, Mass.*
Leach, G. C., *United States Bureau of Fisheries, St. Louis, Mo.*
Leary, John L., *United States Bureau of Fisheries, San Marcos, Tex.*

LeGette, H., *Centenary, S. C.*
Lewis, C. C., *United States Bureau of Fisheries, Northville, Mich.*
Lewis, Charles E., *Chamber of Commerce, Minneapolis, Minn.*
Locke, E. F., *Woods Hole, Mass.*
Lovejoy, Samuel, *Bullochville, Ga.*
Lydell, Dwight, *Mill Creek, Mich.*

Mahone, A. H., *668 Via Monte, Buenos Ayres, Argentina.*
Mallory, Charles, *Burling Slip, New York.*
Manning, W. W., *Marquette, Mich.*
Mansfield, H. B., *Captain United States Navy, 368 Hancock Street, Brooklyn, N. Y.*
Manton, Dr. W. P., *Detroit, Mich.*
Marchers, George, *London, O.*
Marks, H. H., *Sault St. Marie, Mich.*
Marks, J. P., *Paris, Mich.*
Marsh, M. C., *United States Bureau of Fisheries, Washington, D. C.*
Martin, Timothy J., *care of Davis, Collamore & Co., Fifth Avenue, New York City.*
Mathewson, G. T., *Thompsonville, Conn.*
May, W. L., *1655 Market Street, Denver, Col.*
Mayhall, L. B., *Supt. Commercial Trout Co., Sultan, Wash.*
McCook, George M., *Ohio Fish and Game Commission, Steubenville, O.*
McDonald, A. G., *care of A. Booth & Co., Detroit, Mich.*
McDougal, J. M., *Gunnison, Col.*
Mead, Prof. A. D., *Brown University, Providence, R. I.*
Meehan, W. E., *Commissioner of Fisheries, Harrisburg, Pa.*
Meeker, D. W., *Moorehead, Minn.*
Merrill, F. H. J., *Altamont, N. Y.*
Merrill, M. E., *St. Johnsbury, Vt.*
Mershom, W. B., *Saginaw, Mich.*
Miller, Hon. Charles L., *Altoona, Pa.*
Miller, Frank, *Put-in-Bay, O.*
Miller, George F., *Put-in-Bay, O.*
Miller, Walter H., *United States Bureau of Fisheries, Spearfish, S. Dak.*

Miller, W. J., *Scott Depot, W. Va.*
Milligan, Dr. J. D., *United States Bureau of Fisheries, Woods Hole, Mass.*
Mills, G. T., *Carson City, Nev.*
Monroe, Otis, *Mill Creek, Mich.*
Monroe, William, *Mill Creek, Mich.*
Moody, G. C., *Mill Creek, Mich.*
Moore, Charles H., *Detroit, Mich.*
Moore, Dr. H. F., *United States Bureau of Fisheries, Washington, D. C.*
Morgan, H. A., *University of Tennessee, Knoxville, Tenn.*
Morrell, Daniel, *Hartford, Conn.*
Morris, Robert T., D.D., *616 Madison Avenue, New York City.*
Morton, W. P., *Providence, R. I.*
Mussey, George D., *Detroit, Mich.*
Myer, Hon. Charles R., *Atlantic City, N. J.*

Nash, Dr. S. M., *63 West Forty-ninth Street, New York City.*
Neal, John R., *22½ "T" Wharf, Boston, Mass.*
Neal, L. J., *Mill Creek, Mich.*
Nevin, James, *Madison, Wis.*
Norris, J. Olney, *President Maryland State Game and Fish Protective Association, 317 Charles Street, Baltimore, Md.*
North, Paul, *Ohio Fish and Game Commission, Cleveland, O.*

Oberfelder, R. S., *Sidney, Neb.*
O'Brien, W. J., *South Bend, Neb.*
O'Connor, E. W., *Savannah, Ga.*
Ohage, Dr. Justus, *St. Paul, Minn.*
O'Malley, Henry, *Baker, Wash.*
Orahood, H. M., *1010 Seventeenth Street, Denver, Col.*
Orr, W. J., *Bay Port, Mich.*

Palmer, Dr. Theodore S., *United States Department of Agriculture, Washington, D. C.*
Palmer, Stephen S., *Monticello, N. Y.*
Palmer, W. A., *Buchanan, Mich.*
Parker, J. Fred, *Assistant Secretary of State, Providence, R. I.*
Parker, W. H., *Lac la Peche, Quebec, Canada.*

Parkhurst, Hon. C. Frank, *Providence, R. I.*
Partridge, H. E., *Minneapolis, Minn.*
Paxton, Thomas B., *Ohio Fish and Game Commission, Cincinnati, O.*
Peabody, George F., *Appleton, Wis.*
Peoples, Hon. Hiram, *New Providence, Pa.*
Pierce, Captain T. C., *United States Bureau of Fisheries, Washington, D. C.*
Peck, Hon. Stephen, *Warren, R. I.*
Perdum, James K. P., *Woods Hole, Mass.*
Pike, Robert G., *Middletown, Conn.*
Plumb, Charles, *Mill Creek, Mich.*
Pollock, Robert L., *510 Sykes Block, Minneapolis, Minn.*
Pope, T. E. B., *United States Bureau of Fisheries, Washington, D. C.*
Powell, W. L., *Harrisburg, Pa.*
Powers, J. A., *280 River Street, Troy, N. Y.*
Powers, John W., *Big Rapids, Mich.*
Prather, J. Hub, *Lexington, Ky.*
Prendergast, Charles F., *1420 Lincoln Street, Savannah, Ga.*
Preston, Hon. John L., *Port Huron, Mich.*
Preston, Dr. Henry G., *54 Greene Avenue, Brooklyn, N. Y.*
Price, Andrew, *Marlinton, W. Va.*
Price, Calvin W., *Marlinton, W. Va.*
Proctor, Hon. Redfield, *Proctor, Vt.*

Race, E. E., *Green Lake, Me.*
Ramsdale, Frank C., *Bayfield, Wis.*
Randall, G. W., *Plympton, Mass.*
Rankin, J. H., *Ohio Fish and Game Commission, South Charleston, O.*
Rathbone, William F., *D. & H. R. R., Albany, N. Y.*
Rathbun, Richard, *Smithsonian Institution, Washington, D. C.*
Ravenel, W. DeC., *Smithsonian Institution, Washington, D. C.*
Reed, C. A., *Fish and Game Warden, Santa Cruz, Santa Cruz County, Cal.*
Reighard, Prof. Jacob E., *University of Michigan, Ann Arbor, Mich.*
Richards, G. H., *Sears Building, Boston, Mass.*

Rippel, Robert, *Woodruff, Wis.*
Roberts, A. D., *Woonsocket, R. I.*
Roberts, W. A., *United States Bureau of Fisheries, Washingington, D. C.*
Robinson, A. H., *Portsmouth, N. H.*
Robinson, Robert K., *White Sulphur Springs, W. Va.*
Robinson, W. E., *Mackinaw City, Mich.*
Rogers, Frank A., *Grand Rapids, Mich.*
Rogers, J. L., *United States Consul General, Shanghai, China.*
Rogers, J. M., *154 La Salle Street, Chicago, Ill.*
Rooney, James, *Fort Stockton, Tex.*
Root, Henry T., *Providence, R. I.*
Rosenberg, Albert, *Kalamazoo, Mich.*
Ruge, John G., *Apalachicola, Fla.*
Russell, Henry, *Detroit, Mich.*

Safford, W. H., *Department of Fisheries, Harrisburg, Pa.*
Salmon, Alden, *South Norwalk, Conn.*
Sampson, E. R., *care of New York Aquarium, Battery Park, New York City.*
Sanborn, F. G., *612-613 California Street, San Francisco, Cal.*
Saunders, A. A., *Carolina, R. I.*
Saunders, Dr. H. G., *Chattanooga, Tenn.*
Scarborough, L. A., *Columbus, Ga.*
Schley, Dr. F. V., *Columbus, Ga.*
Schute, John A., *Havana, Ill.*
Schweikart, Walter, *Detroit, Mich.*
Seagle, George A., *Wytheville, Va.*
Self, E. M., *Bullochville, Ga.*
Sellers, M. G., *1306 Arch Street, Philadelphia, Pa.*
Sherwin, H. A., *100 Canal Street, Cleveland, O.*
Sherwood, George H., *American Museum of Natural History, 77th and 8th Avenue, New York City.*
Shurtliff, Merrill, *Fish and Game Commission of New Hampshire, Lancaster, N. H.*
Simmons, Walter C., *Providence, R. I.*
Simons, Max, *Columbus, Ga.*
Singleton, James H., *Woonsocket, R. I.*
Slade, George P., *309 Broadway, P. O. Box 283, New York City.*

Smith, Henry D., *Appleton, Wis.*
Smith, H. G., *Minneapolis, Minn.*
Smith, Jay, *care of J. W. Marston & Co., Lewis Wharf, Boston, Mass.*
Smith, L. H., *Algona, Ia.*
Smith, Dr. Hugh M., *United States Bureau of Fisheries, Washington, D. C.*
Smith, J. A., *13 West 25th Street, Baltimore, Md.*
Snyder, Dr. F. D., *10 Center Street, Ashtabula, O.*
Snyder, J. P., *United States Bureau of Fisheries, Spearfish, S. Dak.*
Snyder, J. P., *Tonesdale, Pa.*
Southwick, J. M. K., *Newport, R. I.*
Spencer, L. B., *Superintendent Aquarium, 37 West 128th Street, New York City.*
Spensley, Calvert, *Mineral Point, Wis.*
Springer, F. H., *Columbus, Ga.*
Stapleton, M. F., *United States Bureau of Fisheries, Mammoth Spring, Ark.*
Starbuck, Alexander, *Cincinnati, O.*
Starr, W. J., *Eau Claire, Wis.*
Steele, G. T., *Chicago, Ill.*
Sterling, J. E., *Crisfield, Md.*
Stevens, Arthur F., *227 West Grand Street, Elizabeth, N. J.*
Stevenson, Charles H., *United States Bureau of Fisheries, Washington, D. C.*
Stewart, Charles E., *Westerly, R. I.*
Stewart, A. T., *Northville, Mich.*
Stone, Arthur F., *St. Johnsbury, Vt.*
Stone, Charles A., *Plainfield, N. J.*
Stone, Livingston, *Cape Vincent, N. Y.*
Story, John A., *East Orland, Me.*
Stotz, Martin, *996 Market Street, Philadelphia, Pa.*
Stranahan, J. J., *Bullochville, Ga.*
Stranahan, F. A., *Cleveland, O.*
Stranahan, F. F., *Cleveland, O.*
Streeter, H. R., *Carolina, R. I.*
Sumner, Dr. Francis B., *College of the City of New York, New York City.*

Surber, Thaddeus, *United States Bureau of Fisheries, White Sulphur Springs, W. Va.*

Suthers, Frank, *Madison, Wis.*

Sykes, Arthur, *Madison, Wis.*

Sykes, Henry, *Bayfield, Wis.*

Talbot, Henry, *Interstate Commerce Association, Washington, D. C.*

Tankerslay, A. S., *United States Bureau of Fisheries, Tupelo, Miss.*

Tawes, J. C., *Crisfield, Md.*

Taylor, A. R., *318 Main Street, Memphis, Tenn.*

Taylor, Robert Kirby, *66 Leonard Street, New York City.*

Teal, J. N., *Worcester Block, Portland, Ore.*

Thayer, W. W., *234 Joseph Campau Avenue, Detroit, Mich.*

Thomas, Henry G., *Stowe, Vt.*

Thompson, Carl G., *78 Henry Street, Huntington, Ind.*

Thompson, George B., *Davis, W. Va.*

Thompson, James F., *Martinsburg, W. Va.*

Thompson, William H., *Secretary Anglers' Association of St. Lawrence River, Alexander Bay, N. Y.*

Thompson, W. P., *1020 Arch Street, Philadelphia, Pa.*

Thompson, W. T., *United States Bureau of Fisheries, Leadville, Col.*

Tinker, E. F., *St. Johnsbury, Vt.*

Titcomb, John W., *United States Bureau of Fisheries, Washington, D. C.*

Townsend, A. A., *Carolina, R. I.*

Townsend, Charles H., *New York Aquarium, New York City.*

Trumpour, D. A., *Bay City, Mich.*

Tubbs, Frank A., *Neosho, Mo.*

Tucker, Edmund St. George, *Bedford Row, Halifax, N. S.*

Tucker, Dr. Ernest F., *"The Marquam," Portland, Ore.*

Tulian, Eugene A., *Piscicultor National, 668 Via Monte, Buenos Ayres, Argentina.*

Turner, Avery, *Vice President and General Manager of Pecos Valley Lines, Amarillo, Tex.*

Turner, J. C., *Columbus, Ga.*

VanDusen, H. G., *Master Fish Warden of Oregon, Astoria, Ore.*
Veeder, John J., *Woods Hole, Mass.*
Venn, Harry S., *United States Bureau of Fisheries, Washington, D. C.*
Vincent, W. S., *United States Bureau of Fisheries, Cape Vincent, N. Y.*
Vogelsang, Alexander T., *Mills Building, San Francisco, Cal.*
Von Lengerke, J., *318 Broadway, New York City.*

Walker, Bryant, *Detroit, Mich.*
Wall, Joe, *Salmon, Ore.*
Wallett, W. H., *Put-in-Bay, O.*
Wallich, Claudius, *United States Bureau of Fisheries, Oregon City, Ore.*
Walsh, Joseph, *Woods Hole, Mass.*
Walters, C. H., *Cold Spring Harbor, N. Y.*
Ward, Prof. H. B., *Lincoln, Neb.*
Warner, S. M., *Glen Farm, Dorset, Vt.*
Waterhouse, Rev. E. M., *Broadway and 71st Street, New York City.*
Webb, W. Seward, *44th Street and Vanderbilt Avenue, New York City.*
Wentworth, E. E., *United States Bureau of Fisheries, Baker, Wash.*
Wentworth, Nathaniel, *Hudson Centre, N. H.*
Weed, W. R., *Potsdam, N. Y.*
Wetherbee, W. C., *Port Henry, N. Y.*
Wheeler, Charles Stetson, *Hobart Building, San Francisco, Cal.*
Whish, John D., *Secretary of Forest, Fish and Game Commission, Albany, N. Y.*
White, R. Tyson, *320 Bridge Street, Brooklyn, N. Y.*
Whiting, Caspar, *239 Fifth Avenue, New York City.*
Whitaker, Hon. Andrew R., *Phoenixville, Pa.*
Wilbur, H. O., *235 Third Street, Philadelphia, Pa.*
Wilbur, P. H., *Little Compton, R. I.*
Willard, Charles W., *Westerly, R. I.*
Willetts, J. C., *27 Pine Street, New York City.*
Williams, J. A., *Burlington, Vt.*
Wilson, C. H., *Glen Falls, N. Y.*

Wilson, S. H., *Cleveland, O.*
Winn, Dennis, *United States Bureau of Fisheries, Washington, D. C.*
Winn, S., *Carolina, R. I.*
Wires, S. P., *Lester Park, Duluth, Minn.*
Wisner, J. Nelson, Jr., *United States Bureau of Fisheries, Oregon City, Ore.*
Wolf, Herman T., *489 The Bourse, Philadelphia, Pa.*
Wolters, Charles W., Dr., *Philadelphia, Pa.*
Wood, C. C., *Plymouth, Mass.*
Wood, Frank, *Edenton, N. C.*
Worth, S. G., *Beaufort, N. C.*
Wride, George A., *Grindstone City, Mich.*
Zacharie, Col. F. C., *345 Corondelet Street, New Orleans, La.*
Zweighapt, S., *Deer Park, Haines Falls, N. Y.*

HONORARY.

Borodine, Nicholas, *Chief Specialist in Fish Culture, Department of Agriculture, St. Petersburg, Russia.*
Cortelyou, Hon. George B., *Washington, D. C.*
Denbigh, Lord, *Colonel of the Honorable Artillery Company, London, England.*
Fish Protective Association of Eastern Pennsylvania, *1020 Arch Street, Philadelphia, Pa.*
Fryer, Charles E., *Supervising Inspector of Fisheries, Board of Agriculture and Fisheries, 3 Delahay St., London, England.*
Hamilton, Dr. J. Lawrence, *M. R. C. S., 30 Sussex Square, Brighton, England.*
Hofer, Prof. Dr. Bruno, *Munich, Germany.*
Kishinouye, Dr. K., *Imperial Fisheries Bureau, Tokyo, Japan.*
Lake St. Clair Shooting and Fishing Club, *Detroit, Mich.*
Mrs. Frank M. Johnson, *Boston, Mass.*
Matsubara, Prof. S., *President Imperial Fisheries Institute, Tokyo, Japan.*
Metcalf, Victor H., *Secretary of the Department of Commerce and Labor, Washington, D. C.*
New York Association for the Protection of Fish and Game, *New York City.*

Peck, Hon. George W., *Milwaukee, Wis.*
South Side Sportsmen's Club, *Oakdale, L. I., N. Y.*
The President of the United States.
The Governors of the Several States.
Woodmount Rod and Gun Club, *Washington, D. C.*

CORRESPONDING.

Ayson, Lake F., *Wellington, New Zealand.*
Ayson, Charles L., *Hakataemen, Oamaru, New Zealand.*
Apostolides, Prof. Nicoly Chr., *Athens, Greece.*
Armistead, J. J., *Dumfries, Scotland.*
Birbeck, Edward, Esq., *M. P., London, England.*
Brady, Thomas F., Esq., *Inspector of Fisheries, Dublin Castle, Dublin, Ireland.*
Calderwood, W. L., Esq., *Inspector of Salmon Fisheries, Edinburgh, Scotland.*
Feddersen, Arthur, *Copenhagen, Denmark.*
Feilding, J. B., *Upper Downing, Holywell, North Wales.*
Giglioli, Prof. Enrico H., *Florence, Italy.*
Jaffe, S., *Osnabruck, Germany.*
Landmark, A., *Inspector of Norwegian Fresh Water Fisheries, Christiana, Norway.*
Maccleay, William, *President of the Fisheries Commission of New South Wales, Sydney, N. S. W.*
Marston, R. B., Esq., *Editor of the Fishing Gazette, London, England.*
Olsen, O. T., *Grimsby, England.*
Sars, Prof. G. O., *Christiania, Norway.*
Smitt, Prof. F. A., *Stockholm, Sweden.*
Solsky, Baron N. de, *Director of the Imperial Agricultural Museum, St. Petersburg, Russia.*
Trybom, Dr. Filip, *Stockholm, Sweden.*

RECAPITULATION.

Active	437
Honorary	61
Corresponding	19
Total membership	517

CONSTITUTION

(As amended to date.)

ARTICLE I.

NAME AND OBJECT.

The name of this Society shall be American Fisheries Society. Its objects shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success, and upon all matters relating to the fisheries; the uniting and encouraging of all interests of fish culture and the fisheries, and the treatment of all questions regarding fish, of a scientific and economic character.

ARTICLE II.

MEMBERS.

Any person shall, upon a two-thirds vote and the payment of two dollars become a member of this society. In case members do not pay their fees, which shall be two dollars per year, after the first year and are delinquent for two years, they shall be notified by the treasurer, and if the amount due is not paid within a month thereafter, they shall be, without further notice, dropped from the roll of membership. Any person can be made an honorary or a corresponding member upon a two-thirds vote of the members present at any regular meeting.

Any person shall, upon a two-thirds vote, and the payment of $25, become a life member of this society, and shall thereafter be exempt from all annual dues.

ARTICLE III.

OFFICERS.

The officers of this Society shall be a President and a Vice

President, who shall be ineligible for election to the same office until a year after the expiration of their term; a Corresponding Secretary, a Recording Secretary, a Treasurer and an Executive Committee of seven, which with the officers before named, shall form a council and transact such business as may be necessary when the Society is not in session, four to constitute a quorum.

ARTICLE IV.

MEETINGS.

The regular meeting of the Society shall be held once a year, the time and place being decided upon at the previous meeting or, in default of such action, by the Executive Committee.

ARTICLE V.

ORDER OF BUSINESS.

1. Call to order by President.
2. Roll call of members.
3. Applications for membership.
4. Reports of officers.
   a. President.
   b. Secretary.
   c. Treasurer.
   d. Standing Committees.
5. Committees appointed by the President.
   a. Committee of five on nomination of officers for ensuing year.
   b. Committee of three on time and place of next meeting.
   c. Auditing committee of three.
6. Reading of papers and discussions of same.

   (Note—a. In the reading of papers preference shall be given to members present.
   b. The President and two Secretaries are empowered to arrange the papers of the meetings of the Society.)
7. Miscellaneous business.
8. Adjournment.

ARTICLE VI.

CHANGING THE CONSTITUTION.

The Constitution of the Society may be amended altered or repealed by a two-thirds vote of the members present at any regular meeting, provided at least fifteen members are present at said meeting.